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## COMMUNICATIONS

# NOTES ON THE LATERAL EYES OF SPHENODON WITH SPECIAL REFERENCE TO THE MACULAR REGION

BY

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THE unique zoological position of the Tuatera (*Sphenodon punctatus*) and the fact of its increasing rarity and probable imminent extinction render any opportunity for its investigation of the greatest interest. Its anatomy and the general lines of its development are at present well known (Dendy,[1] Howes and Swinnerton[2] *i.a.*) as are also the main facts concerning the structure of both its parietal and its lateral eyes. It has, however, been my good fortune recently to examine a living specimen and to be able to correlate the ophthalmoscopic and slit-lamp appearances of its lateral eyes with histological specimens, both embryonic and adult. It therefore seems worth while to record my findings, which are in the main confirmatory of the work of other observers. As far as I can discover, no previous published record of the *intra-vitam* examination of the eye exists. The most complete account of the histology of the adult retina is that of Bage.[3] The findings of this observer (whose material I have had the opportunity of examining) are given in a detailed paper published in 1912. This paper should be consulted since I am in complete agreement with its conclusions and do not intend to deal minutely here with the ground covered in it. The observations of

Osawa[4] (1898) on the retina of Sphenodon appear to be inaccurate, possibly owing to the poor condition of his material, since he states, among other discrepancies, that no distinct *area centralis* (or macula lutea) could be found. A year later, however, Kallius[5] corrected this mis-statement by describing and photographing a well-marked fovea, though the state of preservation of his material also left much to be desired. Bage has since (1912) confirmed and extended this work by a detailed description of the fovea in a perfectly fixed specimen.

The present communication is intended to deal mainly with those points which can be observed in the living eye and their histological and embryological confirmation. A short account of the animal itself will first be given, followed by a description of the living eye.

## The Animal

The Sphenodon is the only extant representative of the third order of the Reptilia, the Rhynchocephalia. It thus occupies an intermediate position between the tortoises and crocodiles (Testudinata and Loricata) on the one hand and the lizards and snakes (Sauria and Serpentes) on the other. It is at the present time only to be found on a few islets in the Bay of Plenty, New Zealand (N. Island). The animal nests in a large burrow (2 ft. by 1 ft. and 6 ins. high). This it shares as a breeding place with a petrel, the nest of the bird being usually on the right of the chamber, that of the Tuatera on the left. The eggs of the latter (8-10 in number) are laid in the early summer. Development proceeds for about five months and then comes almost to a standstill till the following spring when it recommences and hatching takes place about mid-summer. The earlier embryonic stages resemble those found in tortoises, the more lizard-like characters being acquired relatively late. The embryos are marked with longitudinal and transverse bands of grey and white, while the adults are variable. The animal has been described as the most generalised of living reptiles. Superficially it resembles a lizard but possesses well developed abdominal ribs. There is geological evidence to show that an aquatic form was once widespread throughout North America and Europe. Fig. 1 gives a rough idea of its general appearance. The specimen I examined had a total length of 44 cm. from the snout to the tip of the tail. The head was 8·5 cm. long, the body 17·5 cm. The skin is of a greenish mud colour and is covered with small tubercles and scales. There is a low crest extending from the neck to the tip of the tail. There are no external ears. The eyes are placed laterally, the angle between the optic axes being 160° or more. On the top of the head is a raised spot of a lighter colour marking the site of the parietal eye. This becomes obscured or converted into a depression with

age. The organ is covered with skin and cannot be seen except on dissection. With regard to the primitive characters and geological antiquity of Sphenodon, Howes and Swinnerton[2] in their monograph on the skeleton state that it "must be regarded as the surviving representative of that group of animals ancestral to all the living Sauropsida and to at least, the Dinosauria, Pterodactyla and Ichthyosauria of the past."

*The Eyes.*—The eyes are provided with thick moveable lids covered with greenish brown scales. The palpebral aperture is

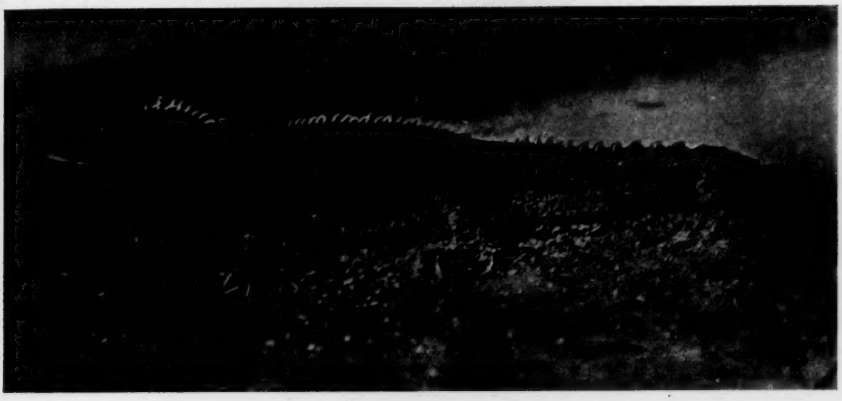


FIG. 1.

Sphenodon punctatus.
(Photo by courtesy of F. W. Bond, Zoological Society).

13 mm. from side to side, and, when the eye is open, 4 mm. from above downwards at its widest part. Since the diameter of the cornea is 5 mm. or slightly more, it follows that the upper and lower corneo-scleral junction is never exposed, and the iris is never seen complete. At the inner and outer canthus a triangular area of ocular conjunctiva is exposed. This is pale green in colour, and is covered with fine capillaries having pale brown walls. The pupil reacts well to direct illumination, changing from a circle to a vertical slit. There does not appear to be any consensual reaction.

*Appearances seen by Focal Illumination.*—The cornea was extremely transparent and completely avascular. Practically no structures could be made out in it. The appearance of the iris is indicated in Fig. 2. The deepest layer of the stroma is a shining silvery buff, but this is only visible in a few very small patches as it is mostly overlaid by splashes of a rich coppery red metallic pigment,

which is in turn obscured in some places by a superficial layer of thin chocolate coloured tissue. The vessels all stand up from this layer in high relief, which becomes more marked towards the pupil, where many of the loops project almost perpendicularly from the surface of the iris. The walls of the vessels are densely coated with chocolate pigment, mixed here and there with the coppery pigment of the stroma. No individual pigment cells are distinguishable, nor is the direction of the circulating blood or its colour anywhere seen.

Fig. 2 shows the arrangement of the vessels. They are all roughly of the same calibre, no distinction being possible between arteries, veins and capillaries. At the margin of the pupil is a narrow flat dark brown zone, which appears to be avascular. Peripheral to this is an anastomotic arcade of large irregular vascular

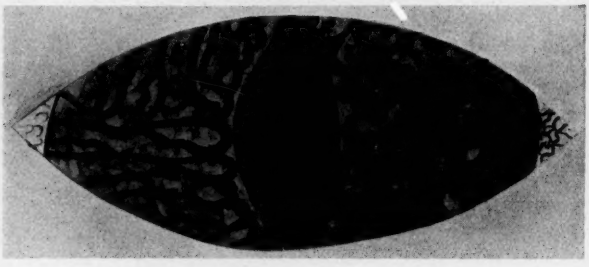


FIG. 2.

Iris of Sphenodon.

loops, fed by a network of vessels covering the rest of the iris. These vessels, though anastomosing freely, run for the most part a course from above downwards in the upper half of the iris and from side to side in its lower half. The lens appears highly curved and extremely translucent. The shagreen is easily visible but no sutures could be made out. The vitreous could not be seen.

*Ophthalmoscopic Examination.*—The fundus reflex was a pale silvery green. The details of the fundus (Fig. 3) were very easily seen with an electric ophthalmoscope, the refraction being hypermetropic.

The optic disc was situated below and to the nasal side of the posterior pole. It was slightly kidney-shaped, its long axis vertical, and its concavity towards the temporal side. It was white in colour, with some greyish areas in the centre and round the edges. In the centre were a very few red capillaries, arranged in small loops (see Fig. 3) and not extending to the edge of the disc. There is no pecten.

The nerve fibres can be easily seen radiating from the disc. They

have a silky sheen, most marked near the disc and becoming gradually less visible as they pass to the periphery. They are non-medullated and are much more easily seen than are those of mammals, possibly because of the greenish background. Their arrangement is interesting, being almost exactly similar to that found in man. On the nasal side of the fundus they radiate evenly from the disc, while on the temporal side they sweep round in a curve above and

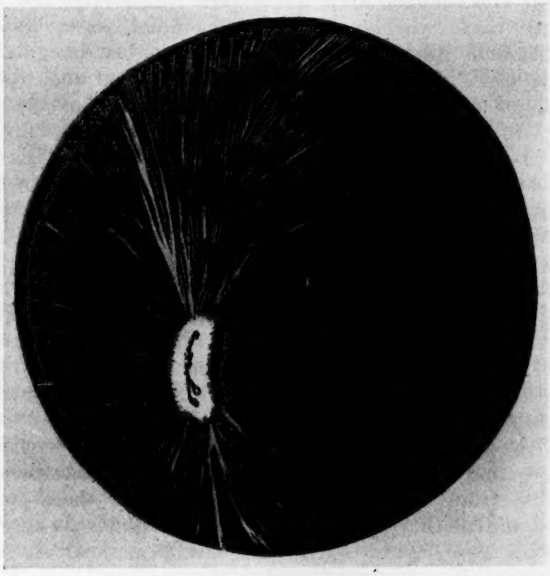


FIG. 3.

Fundus oculi of Sphenodon.

below the posterior pole, leaving a very definite *area centralis* in the situation of the human macula, and meeting in the beginnings of a temporal raphé outside this. The *area centralis*, although the macula itself was not easily seen, shows modification from the rest of the fundus, being darker in colour and more stippled. The general fundus colour is a speckled greyish green, shading into a browner tint at the posterior pole. The whole retina is covered with minute reflecting dots, almost exactly like Crick's dots, and probably caused by the same structures (Müllerian foot-plates). There are no vessels in the retina, and the choroid is nowhere visible through it.

*Comparison of the intra-vitam appearances of the eyes of Sphenodon with those of allied reptiles.*—In its ocular structure, as

in its general anatomy, Sphenodon occupies an interesting intermediate position between the Loricata and the Sauria. The main characters to be considered (shape of pupil, vascular pattern and pigmentation of iris, optic disc and type of fundus) illustrate very well its reputation as a "generalised reptile." In the first place, like the crocodiles and most of the geckos, it possesses a vertical pupil. This is bi-convex in form, not showing any of the specialisations (diamond-shaped openings, umbraculae, etc.) found for example in Gekkonidae and Lacertidae. Secondly, the vascular pattern (an easily visible anastomosing radial network) is intermediate between the crocodile type, in which an irregular net is present deeply embedded in opaque stroma, and the true lizard type in which the superficial radial net is seen to be composed of veins only, the arteries of supply running circumferentially and on a deeper plane. In Sphenodon these circumferential iris arteries appear to be absent. In sections of the adult eye the stroma deep to the large vessels of the network was practically avascular. At the root of the iris there were large capillaries in contact with the pigment epithelium and in the ciliary region a thick walled circumferential artery could be made out. It appears likely, therefore, that the iris vessels arise directly from those of the ciliary region and not from inferior and temporal iris arteries such as are found in most lizards. The iris pattern of Sphenodon therefore resembles most closely that of the crocodiles and the skinks, in which latter family also these arteries are in many species, but not all, invisible. (It should be mentioned that in many snakes also a vertical pupil is present with an irregular network of vessels, arteries being indistinguishable from veins.) In Sphenodon the vessel walls are pigmented and neither the colour of the blood nor its direction of flow can be seen. This is also the case in crocodiles, in a few skinks and lizards and in most snakes.

With regard to the presence of metallic pigment in the iris stroma one can only say that this is a general character, occurring throughout the Amphibia and Reptilia, the most notable exceptions being some of the crocodiles, skinks and snakes. As it is found in even greater abundance in amphibians than reptiles it may be accounted primitive.

The fundus oculi of Sphenodon affords a very good example of a primitive unspecialised type. In the first place its greenish silver colour, shewing the presence of a tapetal layer, is a far commoner background among the vertebrates than is the orange red of the human type. Secondly, the absence of a pecten is of interest. This structure is in all probability a specialised development of the proximal end of the hyaloid artery, correlated with an increasing functional efficiency of the eye. It is found in its most simple form in lizards, and becomes extremely elaborated in birds. It is absent

in crocodiles and amphibians. Rudimentary traces of it occur in some of the lowest mammals (Marsupials) only. In Sphenodon the *arteria centralis retinae* (developed from the proximal end of the hyaloid) is present in a rudimentary and unspecialised form (*i.e.*, a few small branches not extending beyond the disc itself). The same condition occurs in crocodiles and alligators and even in some of the lower mammals. Two diverging lines of specialisation appear to be possible from this primitive vascularisation of the disc, the one culminating in the pecten of the bird, the other in the retinal blood supply of the higher mammals.

The arrangement of the nerve fibres is interesting as it shows that the human arrangement (radial on the inner side, and sweeping round to a temporal raphé on the outer) is also the primitive one and may well be the fundamental vertebrate arrangement although it is not universal. In some of the Marsupialia (*e.g.*, Rat-kangaroo, *Perameles*) the arrangement is entirely radial, no *area centralis* being recognisable (Lindsay Johnson[7]). This should probably be looked on as degenerate rather than primitive. The region of specialised relatively invisible fibres from the posterior pole may well be looked on as the papillo-macular bundle. It is noteworthy that approximately the same extent of the temporal side of the disc is occupied by these fibres in Sphenodon as is taken up by the macular fibres in man. It is thus obvious that specialisation of the posterior pole for form vision begins much lower in the animal scale than was at first thought. It is actually not surprising to find in the ancestor of the Pterodactyls the presence of that macular area which reaches such a high degree of elaboration in its modern avian descendants.

*Histological Confirmations.* In view of the interesting *intra-vitam* appearances of the eyes of Sphenodon, especially those of the fundus, it was thought advisable to attempt some histological corroboration. Through the courtesy of Professor Doris Mackinnon, to whom I wish to tender my thanks, I was enabled to examine the valuable material collected by the late Professor Dendy. These specimens had also formed the basis of Miss Bage's work on the retina mentioned above. The preparations which proved of most value to me were those of the adult eye, and of two advanced embryos (Stages R and S in Dendy's classification) cut serially, the one transversely, the other longitudinally. A short description of these specimens will now be given.

## Histological appearances of the Adult Eye

*The Sclerotic*, like that of many of the lower animals, is in its greater part cartilaginous. This cartilage (hyaline) forms a thin sheet, which ends anteriorly at the corneo-scleral junction by bifurcating into two thin layers separated by a small amount of

fibrous tissue. Posteriorly it exhibits a large fibrous area in the region of the nerve entrance.

*The Cornea.*—This is thin. The stratified epithelium on its surface is of three layers only in most places and the cells are large. Bowman's membrane can with difficulty be recognized as a fine refractile line. The substantia propria contains very few cells. Descemet's membrane is extremely thin, and the endothelial cells covering it are large and flattened, and approximate in appearance much more to the typical endothelial cell than do their more specialised homologues in the corneae of mammals.

*The Choroid* forms a thick, deeply pigmented and richly vascular layer. The innermost layer (chorio-capillaris) is composed of large capillaries closely packed together. This layer is not pigmented, but is embedded in fine fibrous tissue (? tapetal layer). The membrane of Bruch is well marked. The next layer is composed of vessels of varying calibre, many of them extremely large. It is not strictly possible to divide this layer into an intermediate and an outer layer, though doubtless both these typical layers take part in its formation. This portion of the choroid is deeply pigmented. The lamina suprachoroidea is represented by a thin avascular layer of loose pigmented connective tissue in direct contact with the cartilaginous sclerotic.

*The Angle of the Anterior Chamber.*—Unfortunately most of the preparations were somewhat torn here, so that the exact relationship of parts was not certain. Detailed investigation of this region was not therefore considered. It was possible to make out that the angle was well open and the *ligamentum pectinatum* well marked and pigmented. A large vascular channel (canal of Schlemm) could be seen in relation with the bottom of the angle. This contained blood cells, which is in keeping with the observation that during life in many reptiles (especially snakes) circulating blood can be seen in this channel with the slit-lamp. This had not, however, been observed in the living Sphenodon.

*The Ciliary Muscle.*—The longitudinal portion of this could be easily seen. It was composed of striped muscle. The exact relations of its insertion were disturbed in most of the specimens. The circular fibres were not seen.

*The Ciliary Processes.*—These were very small and scarcely more vascular than the choroid. They were covered by two layers of epithelium, the outer only pigmented.

*The Ciliary Nerves* were large and medullated. They ran forward external to the ciliary muscle fibres. A very large circumferential nerve trunk could be seen running round the root of the iris on its anterior surface just in front of the bottom of the angle. This trunk (the connective tissue septa of which are pigmented) gave branches of supply to the muscles of the iris and possibly also to the walls of

its blood vessels, though this could not be made out with absolute certainty.

*The Iris.* This is composed of the following layers from the deep surface forwards.

*(a)* Two layers of pigmented epithelium in apposition. Some proliferation of the anterior of these two layers was visible near the pupil margin.

*(b)* A layer of longitudinally arranged cells, continuous with the tapetal layer of the choroid. Possibly some unstriped muscle was present in this layer but no differential staining had been used. This layer was not vascular except just at the root of the iris where ciliary capillaries extended into it (Fig. 4). It was not pigmented.

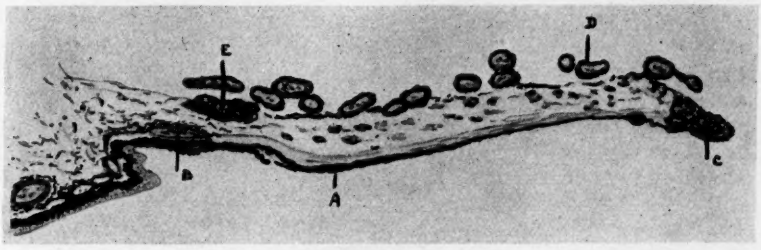



FIG. 4.

Iris of Sphenodon. A=pigment epithelium, B=vessel from ciliary region, C=sphincter, D=Superficial blood vessels, E=nerve trunk.

*(c)* The stroma. This was composed of a very loose tissue, resembling in places unstriped muscle, in places connective tissue. It was continuous with the sphincteric condensation at the pupil margin and also contained pigment cells, these being more numerous in its anterior than its posterior part. It is practically avascular, but contains medullated nerves. The layer is limited anteriorly by a thin pigmented layer which supports the most anterior layer.

*(d)* The layer of large superficial vessels. These vessels, seen mostly in transverse section in Fig. 4, are large, thick walled and deeply pigmented. They stand up in high relief from the surface of the stroma and many of them are actually free in the aqueous in front of this. There is no limiting endothelial layer separating either the vessels or the stroma from the aqueous. (Raised vessels with pigmented walls are common throughout the Reptilia).

*The Retina.*—For a detailed account of this structure Bage's paper should be consulted. She states that the macula is situated 3·5 mm. from the optic disc and that the fovea is 136$\mu$ deep at its

centre. The retina is thickest in the macular region (306$\mu$) and decreases evenly towards the ora serrata (Pars ciliaris 17$\mu$).

The retina is completely avascular though capillaries are present on the disc. The retinal layers are essentially the same as in all vertebrates. Fig. 5 shows the structure of the macula. It will be seen that it resembles that of man very closely indeed, the main

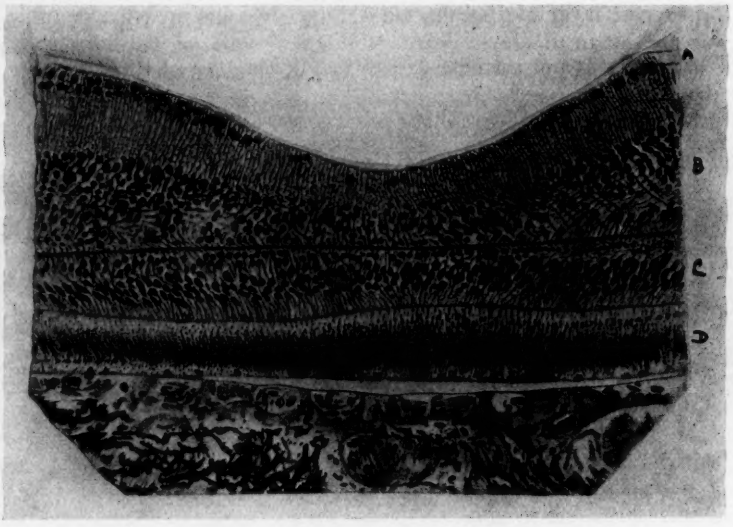



FIG. 5.

Macula of Sphenodon, from Bage. *Quart. Jl. Micros. Soc.*, Vol. LVII, 1912, Pl. 27. A=ganglion cells, B=inner nuclear layer, C=outer nuclear layer, D=cones.

difference being that the layer of bipolar cells shows greater representation.

No rods are present in the retina of Sphenodon (Gamgee[8] has stated that rods are absent throughout the Reptilia) but the cones are of several distinct kinds, both single and double, large and small. They are very long and thin in the fovea.

## Embryological Considerations

The embryological stages of the Sphenodon macula have not, so far as I am aware, been described, and the examination of Professor Dendy's stages R and S was undertaken primarily from this standpoint.

*Embryo of stage R.* This specimen, which was cut transversely, is at the end of the organogenetic period. The eyes are large and occupy a considerable portion of the head, although they are smaller in proportion than would be the eyes of a chick embryo of a corresponding age. The sclera is already cartilaginous in the greater part of its extent although the anterior bifurcated portion is still fibrous. The cornea is very thin and is in close apposition to the anterior surface of the lens. The lens capsule is present. Secondary lens fibres are beginning to form and the annular pad is recognisable. There are no vessels in the vitreous nor is there a hyaloid artery or vascular capsule to the lens. The lid folds are present but are separated by a considerable area.

With regard to the retina one can say that over the greater part of its extent its stage of differentiation corresponds to that seen in a 110 mm. human foetus. That is to say that the three layers of nuclei (ganglion cells, inner and outer nuclear layers) are separate and distinct, but that the inner nuclear layer is still obviously divided into two layers by the transient fibre layer of Chievitz. This is only recognisable as an extremely narrow gap and by the fact that the nuclei internal to it do not take the stain quite so deeply as do those external to it. At the posterior pole the transient fibre layer is more easily recognisable than it is in the equatorial and anterior regions. This points to the beginning of that retardation of differentiation which marks the future macular region in the human embyro from the fifth month onwards. In Sphenodon also the macular region is recognised at this stage, both by the persistence of the transient fibre layer and by the slightly greater thickness of the retina here. This stage was the earliest of the Sphenodon series in which I could find any indication of the position of the future macula. Its earliest appearance therefore resembles in this animal that already well known in man (190 mm. stage approx.).

*Embryo of Stage S.* This specimen was cut longitudinally, and the macular region could be easily identified. Fig. 6 shows the appearance of a model reconstructed from the sections and then cut transversely through both eyes. It will be seen that the maculae are visible as raised circular areas in each fundus, situated above and to the temporal side of the disc. They appear to become displaced downwards later by subsequent growth of the eye. In this model the optic disc lies considerably nearer the lower pole of the eye than it does in the adult. This is merely an expression of the late development of the lower part of the optic cup which is found through the whole range of vertebrate embryos. Microscopically this embryo shows a slight advance on Stage R. The lid folds are almost in apposition and all the tissues are consolidating. In the retina the transient fibre layer of Chievitz is only recognizable

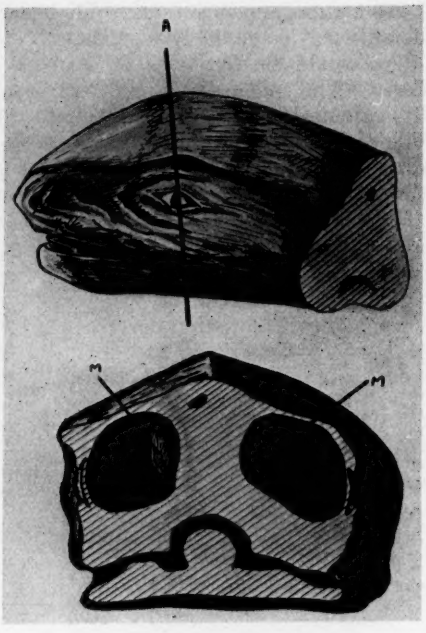


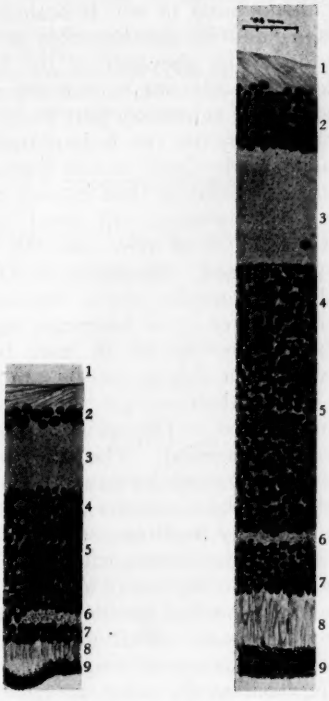

FIG. 6.

Model of Sphenodon embryo (Stage S). 1. Lateral view of head. 2. Transverse section of model along line A. M=macular prominence in each eye.

at the posterior pole. The macular elevation is now extremely marked. Fig. 7 shows two strips of retina (at the same magnification) taken (A) in the equatorial region and (B) at the macula. It will be seen that the increase in thickness of the second involves the nuclear layers much more than the fibre layers. The level of the transient fibre layer can be seen more easily in B than in A.

Unfortunately this was the latest developmental stage available for examination so that it is not possible to state the exact time at which the macula assumes its excavated appearance and its final adult characteristics. It seems however fairly certain that its early stages resemble those of the developing human macula in a striking manner. This, together with the arrangement of the fovea and its nerve fibres in the adult justifies us in drawing a very close parallel between the posterior pole of the eye in the two cases. It may appear remarkable that two species so widely separated as the

Primates and the Rhynchocephalia should show such strong resemblance in both embryonic and adult structure in what might have been considered as one of the most highly specialised regions of the body. The fact may possibly be interpreted as showing in the first




A FIG. 7. B

Sections of the retina of embryo, Stage S. A is from the equatorial region, B from the macular prominence. 1=nerve fibre layer. 2=ganglion cells. 3=inner molecular layer. 4=inner nuclear layer. 5=position of transient fibre layer. 6=outer molecular layer. 7=outer nuclear layer. 8=cones. 9=pigment layer. Both sections are shown at the same magnification.

place how early is the appearance of a retinal area specialised for form vision, or secondly, the human macula may be added to the lengthening list of man's primitive characters. It is interesting to note how on the one hand we find in birds extreme elaboration of the macula, and extension and even multiplication of the site, while, on the other hand, in most mammals (excluding the Primates) there is

either absence of the fovea altogether, or extreme simplification. It is as if the primitive potentialities for accurate form vision fell into abeyance in the lower mammals only to be re-established again with the acquisition of binocular vision. That the position of the eyes had originally nothing to do with the specialisation of a fovea is obvious from its presence in Sphenodon, which cannot have any binocular vision at all, in birds in which both binocular and uniocular vision is found, and in the Primates with true binocular and stereoscopic vision. The abeyance of the fovea in the lower mammals is therefore probably not a correlate of the position of their eyes, but rather of the subsidiary part played by vision which in them is over-shadowed by the rise in importance of the sense of smell. Thus the microsmatic visual human type comes to resemble the primitive ancestor more closely than its own nearer relations.

In all probability further research will reveal that the presence of a well formed fovea centralis is of more common occurrence among reptiles than is now supposed. According to Ovio[9] the crocodile shows a specialised area centralis, while Detwiler and Laurens[10] have described a definite fovea in an American Agama, *Phrynosoma cornutum*. Few observations appear to have been made on the subject. I have myself been able to corroborate Ovio's observation on the crocodile, by ophthalmoscopic examination of a young specimen at the London Zoo. The specialisation of the temporal side of the retina was well marked. The reflex from it was greater, the nerve fibres appeared finer and not so easily visible, nor were they arranged in so regularly radial a manner as on the nasal side. No fovea could be seen, nor any true temporal raphé. On the other hand I was able to see ophthalmoscopically a definite macula lutea with fovea centralis in the living eye of a skink, Tiliqua scincoides. This animal has a small conical pecten, with some visible nerve fibres radiating from its base. Well above and slightly to the temporal side of the pecten is a small bright shining spot, the fovea, with a reflex radiating from it suggesting the macular reflex, but seen as a sector, not as a complete circle. No arrangement of nerve fibres in the region could be made out. The appearance was seen in the eyes of two healthy adult specimens, and is probably normal.

## BIBLIOGRAPHY

1. **Dendy, A.**—On the Structure, Development and Morphological Interpretation of the Pineal Organs and Adjacent Parts of the Brain in the Tuatara (Sphenodon punctatus). *Phil. Trans. Roy. Soc.*, Lond., Series B, Vol. CCI, 1910.
2. **Howes and Swinnerton.**—On the Development of the Skeleton of the Tuatara, Sphenodon punctatus, with remarks on the Egg, on the Hatching and on the Hatched Young. *Trans. Zool. Soc.*, Vol. XVI, p. 1, 1903.
3. **Bage, F.**—On the Histological Structure of the Retina of the Lateral Eyes of Sphenodon punctatus, with Special Reference to the Sense-cells. *Quarterly Journal of Microscopical Science*, Vol. LVII, Pt. 3, Feb., 1912.

4. **Osawa, G.**—Beiträge zur Lehre von des Sinnesorganen der Hatteria punctata. *Arch. f. mikr. Anat. und Entwickl.*, Bd. LII, 1898.
——Ueber die Fovea Centralis von Hatteria punctata. Eine Erwiderung an Prof. Kallius in Göttingen. *Anat. Anz.*, Bd. XV.
5. **Kallius.**—Ueber die Fovea Centralis von Hatteria punctata. *Anat. Anz.*, Bd. XIV.
6. **Mann, I.**—Iris Pattern in the Vertebrates. *Trans. Zool. Soc.*, Pt. 4, 1931.
7. **Lindsay Johnson,**—Contributions to the Comparative Anatomy of the Mammalian Eye, chiefly based on Ophthalmoscopic Examination. *Phil. Trans. Roy. Soc.*, 1901.
8. **Gamgee.**—Text-Book of Physiological Chemistry of the Animal Body. Vol. I, p. 454, Macmillan, 1880.
9. **Ovio.**—Anatomie et Physiologie de l'Oeil dans la Série Animale. Paris, 1927.
10. **Detwiler and Laurens.**—Studies on the Retina: the Structure of the Retina of Phrynosoma cornutum. *Journ. of comp. Anat.*, Vol. XXXII, 3, pp. 347-356, 1920.

Neurol.

# PENETRATING WOUNDS OF THE POSTERIOR CHAMBER OF THE EYE

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## PART I

FIFTY-THREE cases of wounds of the sclera and other coats of the eye exposing the vitreous, were collected chiefly from Sir John Parsons' clinic at Moorfields; of these eighteen were in the region of the limbus and thirty-five were purely scleral wounds. The period covered was from 1905 to 1931. The above numbers do not include sixteen cases where the injury was so extensive that immediate excision was the only possible treatment.

In the present investigation special attention was paid to the question of immediate infection. It was found that no case of acute infection was observed when the wound was scleral exposing the vitreous. Threatened sympathetic ophthalmitis occurred in five cases, four of which were injuries in the region of the ciliary body, and one was scleral. This is in accordance with the accepted view of the greater liability to sympathetic infection in the case of wounds involving the ciliary region.

*Nature of the Injuries.* The majority of the injuries were produced by hot fragments of steel. Four were caused by splinters of glass and one of stone. In two cases the injury was due to direct blows from a spanner. Small pieces of steel are usually sterile and rarely convey bacteria into the interior of the eye. At the same time a prolapse or exposure of vitreous to any organisms which may be present in the conjunctival sac is effected. In one case there were

obvious signs of inflammation of the conjunctiva. Unsuccessful attempts had been made to remove a piece of steel from the vitreous. Three days later the case was sent to hospital when a wound of the sclera with vitreous prolapsing through it was found, with mucous discharge from the conjunctiva and blood in the vitreous. There was no subsequent infection of the vitreous and resulting vision was 6/36.

The time elapsing between receiving the injury and admission to hospital varied from a few hours to seven days.

*Symptoms and Signs.* It was the injury which brought these patients to hospital and they could be further divided into those who complained of mistiness of vision of the affected eye and those who did not. This is an important point, for mistiness of vision usually is due to the occurrence of vitreous haemorrhage along the track of the foreign body.

There was no pain, lacrimation, or spasm of the orbital muscles, as is commonly met with in a similar injury to the cornea. Smirnow found that nerve endings were not numerous in the sclera of the human eye, and this probably accounts for the relative absence of signs of irritation.

The principal signs (in addition to the scleral injury with vitreous presenting) are intra-ocular haemorrhage in fanlike masses, lowered intra-ocular tension from vitreous loss, with increased depth of the anterior chamber. In the absence of haemorrhage, localised clouding of the vitreous in the path of the foreign body can be seen. But this depends on the size of the particle and may be absent in the case of a very fine fragment. Von Thornber (1909) showed that penetration of the vitreous with a needle of three millimetres diameter produced no change, with a thicker needle there was cloudiness in its track. Cases have been recorded where the foreign body remained suspended for a time in the vitreous.

*Infection of the Vitreous following Sclerotic Injuries.* It has been shown by many investigators that the vitreous is susceptible to bacteria and has very little resistance against them. Weber in 1860, Pagenstecher 1870, obtained virulent inflammation on injecting pus from a tear sac into the vitreous. Gifford (1886) used micro-organisms from the conjunctival sac, Perles (1895) sarcinae lutea, and B. subtilis, Deyl (1893), Axenfeld with Katalska (1897), B. xerosis, and after a long interval got inflammation. Leber (1891) used moulds to obtain purulent infiltration of the vitreous. Axenfeld says "many bacteria multiply and develop a very severe inflammatory reaction although in other parts of the eye they would remain encapsulated." He cites B. subtilis "only slightly irritating in the anterior chamber, can produce fulminating suppuration in the vitreous." More recently Cronstedt (1923) agrees as to the good cultural powers of the vitreous.

In injuries of the posterior chamber of the eye infection may result in two ways. The bacteria may be carried into the vitreous with the foreign body or they may subsequently enter from the conjunctiva through the scleral wounds. Szánté designates these as primary and secondary.

*Primary Infection.*—In the present series of cases it has been pointed out that most of the injuries were produced by fine fragments of steel which were heated and therefore sterile, so that few, if any, bacteria would be carried in by them, and this is borne out by the absence of infection. There was only one case of shrapnel injury. War wounds, on the other hand, were produced by irregular pieces of steel and stone which by their irregular surface rendered adherence of infective material easy. In addition many were indirect injuries, *i.e.*, the missiles in many instances first struck the ground and were then deflected into the eye. Many wounds were caused by shell and mine explosions. Thus infection was more common with this type of injury in the war. Lister (1918), Hertel (1922). Lister, however, states that panophthalmitis following war wounds is not of an acutely virulent type. Further, in the official History of the War it is noted that removal of the foreign body was rarely followed by septic complications.

Other records show a certain incidence of panophthalmitis. Goulden had seven cases, all of them cornea and lens injuries, in 118 penetrating injuries of the eye. In Brownlie's series, out of 17 purely scleral wounds two developed panophthalmitis. Allport reports panophthalmitis in 10 instances from 90 scleral wounds. On the other hand, cases of scleral injuries with retained foreign body have been reported by Fisher, Maitland Ramsay and others, which made excellent recoveries following removal of the fragment.

It is evident that bacterial inflammation of the vitreous occurs in a certain percentage of cases and is dependent on the nature and size of the entering fragment.

*Secondary Infection.*—When vitreous is prolapsed through a scleral wound which is also bounded by portions of the choroid and retina, it is not only exposed to any micro-organisms contained in the conjunctival sac, but a pathway is established leading into the interior of the posterior chamber where bacteria could find what would appear to be excellent conditions for their growth and propagation. Duane, in the revised 7th edition of Fuchs' text book contrasts the good prognosis of wounds of the anterior segment of the eye where aqueous flows out and washes the wound, with those of the posterior segment. In the latter he states "the vitreous sticks in the wound and affords a convenient path for the entrance of germs." Similar views are held by de Schweinitz. Friedenwald says there is no living cell in the vitreous and Anderson states "that bacteria spreading in from the neighbouring parts are free

from the inhibiting action of the tissues. They multiply rapidly and abscess formation occurs."

Axenfeld has stated that the normal conjunctiva contains regularly B. xerosis and non-virulent staphylococcus albus. Two cases are reported of inflammation following cataract extraction where only white staphylococci were found. Bach found twenty-seven varieties of bacteria in one hundred conjunctivae. It is apparent, then, that a prolapse of vitreous will have ample opportunities of coming into contact with many different bacteria.

Prolapse of vitreous was present in a marked degree in fourteen cases of the present series. The duration of exposure was in some cases two to three days. In one patient there was obvious infection of the conjunctiva for three days, whilein another seven days were allowed to elapse before treatment was sought. Yet in all these instances no infection of the vitreous resulted, and useful vision was obtained.

The amount of exposure of the vitreous was dependent not only on the size of the wound, but also on its direction. The sclera consists of connective tissue bundles arranged meridionally and equatorially. According to Salzmann the equatorial arrangement predominates in the neighbourhood of the optic disc and in the scleral roll immediately external to the cornea. More external to this roll the fibres, especially the superficial ones, have a meridional direction, and as this part is immediately under the bulbar conjunctiva it is the part which is injured, the area of sclera behind the equator being well protected by muscles, etc. It will be seen that a meridional injury of the sclera will not gape, and thus less vitreous will be exposed. Further, the overlying conjunctiva will tend to close over the wound and lend additional protection. There were twelve such wounds in our series. The remainder, however, were in the direction across the long axis of the scleral fibres and their margins were therefore drawn apart. In addition, cases occurred where a piece of the scleral wall was missing, and it was in the latter that marked prolapse of vitreous had taken place.

There is thus no clinical evidence in the present series for the view that a prolapse of vitreous affords entrance to the interior of the vitreous of destructive bacteria. In the second section of this paper experimental proof will be given that exposed vitreous has considerable powers of resistance against bacterial infection.

*Loss of Vitreous.* This occurred in five cases to a considerable degree and was evidenced by the low tension and the increased depth of the anterior chamber. They had no haemorrhage. The direction of the wound was meridional 2, equatorial 2, and the remaining one with a large transverse wound of the cornea opening up the sclera on each side. The amount of vitreous lost seems to be dependent on the amount of the initial trauma. It is least in

injuries produced by a small fragment travelling at great velocity. In some of these cases the initial wound was quite small. Vitreous, once the initial injury was past, did not tend to drain away. It adheres to the margins of the wound, for in several cases the tension was not very much diminished although there was a fair sized scleral wound (3 mms. by 2 mms.).

The vitreous has been described as consisting of a thickened anterior border behind the ciliary body and lens, and a posterior border beginning at the ora serrata, becoming thinner posteriorly (v. Szily, Woolfrum, Fischel). Retzius described fasciculi which are thicker and close together at the periphery. Virchow and Greeff also hold that it possesses a definite structure. Lauber believes that by virtue of a thickened outer zone the vitreous in accidental or operative wounds can appear without any loss and under favourable conditions can withdraw again, as for example, after discission following cataract extraction. This thickening of the outer part of the vitreous could explain cases of scleral wound where there is evidence of little loss of vitreous. Baurman, however, from his investigations with the ultramicroscope believes that the vitreous is an undifferentiated gel and that the appearances seen in microscopic sections can be attributed to the effect of fixatives used.

Loss of vitreous did not apparently hinder the subsequent recovery of vision. The normal tension of the eyes was quickly established after the scleral wound had been covered with a conjunctival flap. This was due to the outpouring of fluid by the ciliary body. Löwenstein and Samuels hold that one-third of the vitreous volume can be lost without serious effects. The danger is that a sudden loss will cause a detachment of the retina. Ford (1890), Elschnig (1911), zur Nedden (1920), advocate withdrawal of vitreous in infection. Birch-Hirschfeld reported that a considerable number (72 per cent) of cases of detached retina had occurred. Hudson has drawn attention to the frequency of serous detachment of the choroid in perforating injuries when the ocular tension remains low. There were in the present series three cases of injury with extensive detachments of the retina; one of them was seen one month after the initial trauma. It is interesting to note that none of them suffered much loss of vitreous at the time of the accident. As the original five cases of extensive vitreous loss were not followed up it is impossible to speak of the ultimate prognosis, for detachment of the retina has been reported after two years, Zazkin (1905), four years, Mergel (1903), eight years, Scharg (1907). In one of our cases detachment ensued after two years. This patient had 6/9 vision thirteen months after the injury, vitreous was clear; there was an anchored opacity below at the site of the scar. These cases of late detachment were probably due to the pull of fibrous tissue which fills the site of the original wound. This explanation, of course,

cannot account for cases of early or immediate detachment. In the latter it would seem that the amount of the original trauma more than vitreous loss, was the deciding factor.

*Haemorrhage.* Haemorrhage into the vitreous was present in eleven cases. The amount varied from profuse haemorrhage necessitating excision of the eye to a fine streak in the path made by the foreign body. Wounds at the extreme periphery of the retina show the least amount for there the vessels are small. The size of the wound of the sclera was not strictly proportional to the amount of haemorrhage, for in a small wound a vessel of considerable size can be divided. The fall in intra-ocular tension has been shown to lead to retraction of the retinal and choroidal vessels and their elastic coats can exert their whole pressure on the blood stream (Parsons).

Typically the blood occurs in fan-shaped masses along the track of the missile. This is attributed by Lister to the splitting of the vitreous by the initial trauma. Fuchs says that haemorrhage fills the space between the vitreous and retina but Lauber considers that this is due to the blood tearing the vitreous away from the retinal surface. Birch-Hirschfeld (1909) on aspirating vitreous found it separated from the retina.

In the absence of haemorrhage it was found that the vision was little impaired. Where haemorrhage has occurred there is a gradual clearing of the vitreous but the vision seldom returns to normal. Also the presence of haemorrhage leads to the formation of fibrin and although this is mostly absorbed by polymorphonuclear leucocytes, the new fibrous tissue formed by the mesoblastic element of the choroid and episcleral tissue is increased so that a dense scar is formed which may from its bulk impair vision. This was noted in four cases. Most of these eyes are lost subsequently.

*Phthisis Bulbi.*—Shrinkage of the eyeball was observed in three cases, all of them scleral wounds. There was diminution of ocular tension, the cornea flattened and became smaller. The anterior chamber became shallow and there was haemorrhage from the iris. Similar results have been reported by Goulden, Ramsay and others. These cases are probably either due to trauma or to a chronic infection.

*Trauma.*—Whether the vitreous be an undifferentiated gel or a tissue there must be some relation between the fibrils and the fluid part. The fluid, according to Raeder, is adsorbed to the fibrils. The amount adsorbed probably depends on the pressure and also on the chemical changes in the fluid. This relationship is a delicate one and liable to be upset easily by external influences such as trauma resulting from a penetrating steel fragment. Löwenstein estimates the albumin content of the vitreous as 0·02 per cent., while the subretinal fluid is rich in albumin. In the case of a

detachment with a hole, this albuminous fluid will escape into the vitreous. The quantity of albumin also increases in other pathological conditions.

Haab's first consideration in removing foreign bodies was to traumatise the vitreous as little as possible.

The influence of haemorrhage on the vitreous is another factor which calls for consideration. Parsons says that the wounding of a large vessel "adds immeasurably to the severity of the condition." Fluidity of the vitreous results after absorption of a large haemorrhage (Lauber). The absorption of blood clot must also lead to a disturbance and damage of fibrils. Ellett has drawn attention to "through and through injuries where there is much bleeding even when the ciliary region is not involved, these cases tend to develop a chronic iridocyclitis with quiet periods leading to shrinkage." A certain proportion of cases of sclerotic injuries after removal of the foreign body tend to develop a type of plastic iridocyclitis.

*Late Infection.*—Late infection occurred in two cases of this series, both wounds of the limbus. Two months after the injury they were admitted to hospital with keratic deposits on the back of the cornea. Under treatment these disappeared with resulting vision of 6/36.

Other cases of chronic infection have been reported. Deutschmann had a case of chronic inflammation with shrinkage. Approximately three years afterwards the eye was removed, and bacteria found. Another one, one and a half years after injury, showed cocci and diplococci in the ciliary region. Berry and Schmidt-Rimpler give further evidence of the latency of bacteria in the eye. Chodorowsky injected measured quantities of staphylococcus aureus, streptococcus pyogenes and bacillus pyocyaneus, and by plating was able to obtain bacteria after 20 days, and 2 months (staphylococci), pyocyaneus after three months.

Lastly, an eye, which has been damaged by a penetrating foreign body, may have its function deranged and its resistance lowered. In such circumstances any bacteria which may be circulating in the blood from some distant focus may there find a suitable nidus to settle in.

It is thus difficult to assess the respective importance of trauma and infection in causing shrinkage of the eye.

The treatment adopted was to remove the foreign body through the scleral wound in cases where it was accessible, otherwise the anterior route was used.

## Summary

Evidence has been brought forward to show that vitreous exposed through a wound of the posterior chamber of the eye did not become infected in the majority of cases. In fifty-three cases there

was no panophthalmitis. Other figures give two out of seventeen, ten out of ninety. This refers to acute infection and seems to show that a prolapse of vitreous does not afford a ready entrance of bacteria into the interior of the posterior chamber.

A proportion of cases showed subsequent shrinkage of the eyeball, and it was difficult to determine to what extent bacteria were responsible for this.

## REFERENCES


**von Thorner.**—*Arch. f. Ophthal.*, Bd. LXIX, S. 391.
**Weber.**—*Virchow's Arch.*, Bd. XVI, 1859; Bd. XIX, 1860.
**Pagenstecher.**—*Arch. f. Augenheilk., u. Ohrenheilk.*, Bd. I, 1870.
**Gifford.**—*Arch. f. Augenheilk.*, Bd. XVI, 1886.
**Perles.**—*Virchow's Arch.*, Bd. CXL, 1895.
**Deyl.**—Böhmische Akademie der Wissenschaft., 1893.
**Katalska.**—West. Opt., 1897.
**Leber.**—Die Entstehung der Entzündung, 1891.
**Axenfeld.**—Bacteriology of the Eye, p. 86, 1908.
**Cronstedt.**—*Svenska lakaresallskapets handb.*, Bd. XLIX, H. 3, S. 157, 1923.
**Lister.**—*Lancet*, July 20, 1918.
**Hertal.**—*Handbuch der aertztlichen Erfah. in Weltkreige*, Bd. V, Leipzig, 1922.
**Szánté.**—*Klin. Monatsbl. f. Augenheilk.*, Bd. LIX, S. 76, 1917.
**Goulden.**—*Roy. Lond. Ophthal. Hosp. Reps.*, Vol. XVII. part II.
**Brownlie.**—*Ophthalmoscope*, Vol. XIV.
**Allport.**—*Amer. Jl. of Ophthal.*, Vol. VIII, p. 472, 1925.
**Fisher.**—Hunt. Lect., February 5, 1930.
**Maitland Ramsay.**—Eye Injuries and their Treatment, 1907.
**Anderson.**—Detachment of Retina. Camb. Press, p. 33, 1931.
**Duane.**—Fuchs' text-book. 7th edit. revised, p. 96.
**Bach.**—*Arch. f. Ophthal.*, Bd. XL, H. 3, S. 5130, 1894.
**v. Szily.**—*Anat. Anz.*, 24, Nr. 16 and 17; *Anat. Hefte-Haft*, 109, 1908.
**Salzmann.**—*Anat. u. Hist. des Mensch. Augapfel*, Leipzig, 1912.
**Woolfrum.**—*Arch. f. Ophthal.*, Bd. LXV, S. 220.
**Hudson.**—*Roy. Lond. Ophthal. Hosp. Reps.*, Vol. XIX, p. 301.
**Retzius.**—Ueber den Bau des Glaskörpers und der Zon. Mensch. August, 1894.
**Virchow.**—*Ophthal. Ges., Heidelberg*, 1885; *Ergebn. d. Anat. u. Enburck.*, Bd X, S. 727.
**Greeff.**—*Arch. f. Augenheilk.*, Bd. LIII, S. 119; Lehrbuch spec., Path., und Anat., III, Lieferung, 5583.
**Baurman.**—*Arch. f. Ophthal.*, Bd. III, S. 352.
**Löwenstein and Samuels.**—*Ophthalmology*, January, 1915.
**Ford.**—*Lancet*, p. 462, 1890.
**Elschnig.**—Ueber Glaskorper ersatz. *Bericht. ueber die* 37 *Vers., d. Ophthal. Gesellschaft, Heidelberg*, 1911.
**zur Nedden.**—*Arch. f. Ophthal.*, Bd. 101, S. 5145.
**Parsons.**—*Roy. Lond. Ophthal. Hosp. Reps.*, Vol. XV, pp. 215-253.
**Birch-Hirschfeld.**—Exper. Stud. Netzhautabhebung. Forts. der Med. Nr. 13, 1911.
**Haab.**—*Jn. Amer. Med. Ass.*, August 30, 1902.
**Deutschmann.**—*Arch. f. Ophthal.*, Bd. XXXI, S. 527.
**Berry.**—Verhandl. d. X Internat.-Med. Congress, Bd. IV, H. 5, S. 125.
**Schmidt-Rimpler.**—Heidelberg Congress, 1891.
**Chodorowsky.**—Zur Frage der Lebensdauer einiger Bakt. in Auge. *Inaug. Dissert.*, Petrograd.
**Lauber.**—*Handbuch der ges. Augenheilk.*, Bd. V, 3rd Abl.
**Ellett, E. C.**—*Trans. Amer. Ophthal. Soc.*, Vol. XXV, p. 64.

## PART II

### Introduction

In the first section attention was drawn to the relative infrequency of panophthalmitis following penetration of the vitreous containing chamber of the eye by foreign bodies. This was to some extent explained by the aseptic nature of the entering fragment and the consequent absence of implantation of bacteria in the interior of the eye. At the same time, however, the wound of the sclera, choroid and retina incident on such injuries exposed the vitreous to the bacteria of the conjunctival sac, constituting a possible pathway for the entry of infection. Liability to infection on the part of the vitreous must therefore be estimated from two aspects, (1) where the bacteria were deeply placed in its interior, and (2) when the superficial part of the vitreous only was exposed.

*Insertion of Bacteria into the centre of the Vitreous.* In thirty rabbits virulent bacteria were introduced into the middle of the vitreous by means of a syringe, the needle penetrating the sclera, choroid and retina. In every case panophthalmitis resulted.

*Bacteria.* The following bacteria were used:—

(1) Bacillus pyocyaneus, five different strains. This micro-organism was found to be the most virulent and this is in conformity with the well-known susceptibility of the rabbit to this bacillus. It thus constituted a severe test and was used in the majority of the experiments. Other organisms used were staphylococcus aureus, haemolytic streptococcus, bacillus coli, pneumococci, b. subtilis and a diphtheroid bacillus. Although these produced a less acute type of inflammation, the results conformed to those produced by bacillus pyocyaneus.

The number of bacteria used in each experiment was fifty million bacteria (judged by opacity) of a twenty-four hours culture on agar made from a fresh meat basis, suspended in normal saline.

*Technique of Injection.*—To avoid haemorrhage a point on the sclera away from the insertion of the muscles was chosen, and with the point of a keratome a small incision was made till vitreous presented in the wound. This was necessary because the toughness of the sclera prevents penetration by a needle. The sites chosen were the upper, lateral and lower fornices A hypodermic needle with attached syringe containing the bacterial suspension was used for the injection, but before this was done a quantity of vitreous slightly greater than the amount to be injected was withdrawn. This prevented the vitreous forcing the entering suspension into the subconjunctival space. The needle was inserted to a depth of five millimetres from the conjunctival surface into the vitreous in a backward and inward direction, and its position verified by ophthalmoscopic examination. Only rabbits with normal fundi were used. The amount of the suspension injected was one drop (·001 c.c). The trauma inflicted by this operation was confined to that produced by the local incision through the sclera and other coats of the eye. All rotatory movements were avoided.

Prolapse under a flap.

## Description of Inflammation

(1) ***Clinically.*** An effusion behind the lens, between its posterior capsule and the anterior part of the vitreous appeared in twelve hours and obscured the fundus. Congestion of the conjunctiva did not appear till twenty-four hours after the injection. It was accompanied by slight conjunctival discharge. The cornea was clear and the most characteristic sign was the ground-glass appearance on the posterior surface of the lens which was due to the effusion noted above. As infection proceeded, the conjunctival congestion increased but there was never much discharge until the cornea became secondarily infected. At the end of the second day pus appeared in the anterior chamber and some oedema of the lower part of the cornea. This proceeded to the development of an abscess. Perforation occurred on the third day at the corneo-sclerotic junction. There was considerable constitutional effect and sometimes contraction of the neck muscles of the same side as the infected eye.

(2) ***Macroscopically.*** When such an eye in the early stages (twenty-four hours) was split open a thin layer of pus lay on the surface of the retina extending on to the posterior surface of the lens capsule. The vitreous was quite clear and was ringed round

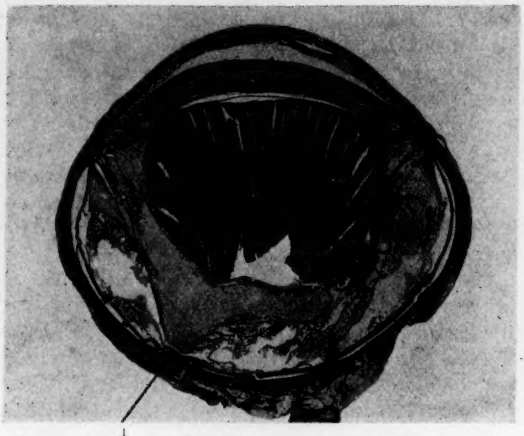
with pus. The depth of the surrounding layer of pus increased as infection proceeded and just before perforation, occupied an area equal to one-sixth of the total space. Penetration towards the centre was not very marked. There was less pus behind the lens than elsewhere.

(3) *Microscopically*. The earliest changes, as seen within two hours of infection, appeared to be a well marked extensive engorgement of the vessels of the choroid. Perivascular spaces not infrequently contained free red corpuscles, and at a slightly later period these could be seen passing into adjacent tissues, such as the retina, coming to lie on the surface of the vitreous. Polymorphonuclear leucocytes soon appeared, their deeply stained lobes standing out in marked contrast to the well stained erythrocytes. The site of infection appeared to be determined by the mode of introduction of the organism: the earliest reaction occurring in the ciliary region corresponding to the site of injection and frequently also at the optic disc area around the central vessels of the retina. At twelve hours, acute inflammation of the choroid and ciliary body was rapidly proceeding and the presence of numerous polymorphs in the anterior chamber of the eye and the ciliary process of the opposite side of the same eye, suggested an active spread of the infection. With the lapse of twenty-four hours a panophthalmitis had developed in most instances. In striking contrast was the almost complete absence of change in the vitreous. Spread from the neighbourhood of the ciliary body appeared to have been determined by the resistance of the vitreous; the region of the optic disc seems to have been an especially favourable site for the early development of infection and from here also the spread was superficial, so that two advancing zones of leucocytic infiltration could be seen passing forwards to meet those arising at the ciliary region.

In the later stages, from forty-eight hours onwards, the leucocytes had invaded the superficial layer of the vitreous forming a distinctive zone between the retina on the one hand and the vitreous on the other. The vitreous had thus become surrounded by a covering of leucocytes. Later the leucocytic infiltration between the vitreous and the retina appeared greatly to exceed that posterior to the lens.

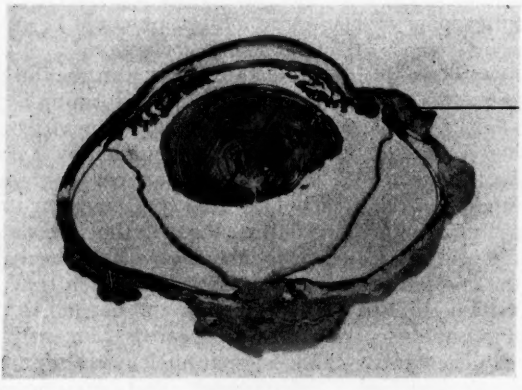
The type of cell varied with the stage of the infective process. At first there was a simple engorgement of all the available blood spaces of the choroid with red corpuscles. This, in time, extended outwards to structures in Tenon's capsule and beyond to the orbital fat. Polymorphonuclear leucocytes appeared at an early stage and soon showed degenerative changes, their nuclei staining more deeply and becoming pyknotic. Histiocytes and lymphocytes were numerous. Smears from the central clear area of the vitreous were found to be free from cells and bacteria, whereas films from the periphery consisted almost entirely of leucocytes. Disorganisation

of the retina occurred frequently with scattering of pigment cells. Not uncommonly, however, it appeared to be normal although in close proximity to inflammatory cells.



Disc. With cellular exudate on either side which has lifted the vitreous (V) away from retina. X—Exudate or cells from ciliary body.

Deep injection (3rd day) of B.pyocyaneus into centre of Vitreous.




Whole Eye. Prolapse under flap (3rd day).
(Note retina has become detached from choroid.)
No cells can be seen in Vitreous.

*Vitreous as a Culture Medium in Vitro.*—The obtaining of 100 per cent. ratio of infection when micro-organisms are injected into the interior of the vitreous suggested that bacteria must there find excellent conditions for growth. This is in agreement with the generally held view. Vitreous was removed from the eye and used as a culture medium in the test tube when it appeared to be a reasonably good medium. For B.pyocyaneus it was comparable with such a highly specialised laboratory medium as nutrient broth, and in the case of B.subtilis, staphylococcus, pneumococcus and streptococcus, the growth of these organisms on vitreous never appeared less than one-twentieth of that obtained in broth.

*Technique.*—The vitreous was aspirated under aseptic conditions from the rabbit's eye immediately after excision, twenty minims being placed in a series of tubes. As wide a tube as possible was used in aspirating to minimise the deformation of vitreous, on which much may depend in the response to infection. A tube of quarter-inch bore was found to be the most suitable. In every experiment, tubes with vitreous were set apart and incubated for one week to test the asepsis of the proceeding. The bacteria chosen were B.pyocyaneus, pneumococcus, staphylococcus aureus, B.coli and streptococci. Twenty-four hour cultures were used, and the amount injected was measured in each case. The enumeration was done by plating. The comparison was made with a similar amount of nutrient broth.

The following is an average of three experiments.

| | *Vitreous* Inoculum | *Broth* 50 millions per c.c. |
|---|---|---|
| ***B.pyocyaneus*** | | |
| 1 ... ... | 875 millions per c.c. | 834 millions per c.c. |
| 2 ... ... | 828 „ „ | 870 „ „ |
| 3 ... ... | 836 „ „ | 810 „ „ |
| ***Pneumococcus*** | | 12 millions per c.c. |
| 1 ... ... | 180 millions per c.c. | 500 millions per c.c. |
| 2 ... ... | 200 „ „ | 486 „ „ |
| 3 ... ... | 236 „ „ | 490 „ „ |
| ***Staphylococcus*** | | 12 millions per c.c. |
| 1 ... ... | 80 „ „ | 378 millions per c.c. |
| 2 ... ... | 200 „ „ | 650 „ „ |
| 3 ... ... | 168 „ „ | 400 „ „ |
| ***Streptococcus*** | | 4 millions per c.c. |
| 1 ... ... | 76 „ „ | 500 millions per c.c. |
| 2 ... ... | 64 „ „ | 430 „ „ |
| 3 ... ... | 68 „ „ | 520 „ „ |

With exception of B.pyocyaneus, where the amounts of growth were equal, the other micro-organisms find vitreous not such a suitable medium as nutrient broth. But, that the vitreous is quite a good culture medium cannot be disputed, as in every case there was free multiplication of the original number of bacteria inoculated.

*Surface of the Vitreous.* The second method of infection suggested was by active penetration of the surface vitreous by bacteria as it lies prolapsed through the margins of the wound. This was investigated by experiments *in vitro* and *in vivo*.

*In Vitro Experiments.* Although the vitreous when aspirated and removed to the test tube is a good culture medium, it is possible that the relatively intact vitreous with its gel structure preserved might prove an unsuitable medium for bacterial growth. An attempt was made to investigate this point by removing the entire vitreous with as little damage to its consistency as possible into a Petri dish. When carefully removed the vitreous maintains a semi-rigid consistency and it may be used as a medium for the surface growth of bacteria in the same way as agar medium. When the growth of an implant of staphylococcus on the surface of such a removed vitreous was compared with that of an equal area of ordinary agar medium, it was found that the growth on vitreous was much inferior to that of agar, but a sufficient number of colonies grew up on the vitreous to make it impossible to say that there was any real protection of an exposed vitreous surface against bacterial invasion. The discrepancy between the agar growth and that of the vitreous can probably be paralleled by the discrepancy between agar growth and growth of bacteria on any tissue or exudate. Staphylococci were used in this experiment because B.pyocyaneus tends to form a spreading colony on nutrient surfaces. Special sizes of Petri dishes were necessary owing to the small amount of vitreous available. Precautions were also taken against drying in the incubator by putting the special dishes into ordinary Petri plates containing sterile water.

The eyes were immediately excised after killing the rabbits and with aseptic precautions the vitreous was evacuated through an opening equal to half the circumference of the globe, into a number of the small dishes. An equal amount of suspension of a twenty-four hours growth of staphylococcus aureus was sprayed over the surface by means of a fine pipette to ensure uniform distribution. Nutrient agar (prepared with a fresh meat basis) was the medium used in comparison, under the same conditions as regards size of dish and amount of suspension of bacteria used. The inoculating culture was distributed so as to give twenty colonies on the agar plate.

*After 48 hours*

| | *Plate* | *Vitreous Colonies* | *Control Colonies* |
|---|---|---|---|
| A | 1 | 0 | 12 |
| | 2 | 2 | 10 |
| | 3 | 0 | — |
| | 4 | 0 | — |

Bacterial suspension increased to 100 colonies

| | | | | | | |
|---|---|---|---|---|---|---|
| B | 1 | ... | ... | 8 | ... | ... 147 |
| | 2 | ... | ... | 7 | ... | ... 132 |
| | 3 | ... | ... | 0 | ... | ... — |
| | 4 | ... | ... | 6 | ... | ... — |

Bacterial suspension increased to 1000 colonies

| | | | | | |
|---|---|---|---|---|---|
| C | 1 | ... | ... | 6 | ... Uniform film of |
| | 2 | ... | ... | 9 | ... minute colonies |
| | 3 | ... | ... | 7 | ... impossible to |
| | 4 | ... | ... | 5 | ... enumerate |

Although scanty growth was thus obtained on vitreous in the above experiments if the vitreous used was replated on to agar good growth of the bacteria was obtained. To determine whether the micro-organisms during their sojourn on the surface of the vitreous were diminished in number, measured amounts of *B.coli*, pyocyaneus, and staphylococci were placed (1) in normal saline, (2) on to plated vitreous, and at the end of 24 and 48 hours their number was determined. It was found that vitreous had caused no diminution in the numbers of the micro-organisms.

*In vivo experiments.*—The surface of vitreous as it prolapses through a wound of the sclera and other coats of the posterior chamber was inoculated with B.pyocyaneus. No general infection of the vitreous took place in eighty-six per cent. of cases.

The total number of rabbits used was ninety-six. Of these forty-eight were simply experiments in which a prolapse of vitreous was produced through a three millimetre incision. In the remainder, variations were made either to ensure a wider exposure of the vitreous or to exclude some additional factor such as the action of the lacrimal secretion or trauma. This latter group will be described in detail subsequently.

*Technique.*—The rabbit's eye was first examined to ascertain if normal. An incision was then made down to the vitreous three millimetres in length; when vitreous appeared in the wound the knife was turned at right angles and to ensure gaping, a slight cut was made. The positions chosen were the upper, middle and lower fornices.

To a twenty-four hours' growth of B.pyocyaneus on agar, made with a fresh meat basis, enough saline to extend half-way up the slope was added. A concentrated suspension of the bacteria was thus obtained. With this the conjunctival sac was filled, and the surface of the prolapsed vitreous covered with B.pyocyaneus. To ensure that the bacteria used were virulent, controls were established in each experiment—some of this suspension was injected into the centre of the vitreous of normal rabbits at the same time in the following way. A quantity of the suspension of B.pyocyaneus was placed in an all-glass syringe whose needle was then introduced 5 mm. into the vitreous through a small keratome stab wound of the sclera choroid and retina. The barrel of the syringe was held perpendicular to the plane of the sclera. No pressure other than the weight of the syringe piston was used. The syringe was withdrawn as soon as the desired depth of penetration was obtained.

All these controls developed panophthalmitis. Of the forty-eight cases of prolapsed vitreous, seven developed infection of the prolapse.

*Variation of the Size of the Prolapse of Vitreous.* The amount of vitreous which appeared in the wound was proportional to the size of the incision. In five rabbits three eyes were used as controls in the manner above described and prolapse of vitreous, over which suspension of B. pyocyaneus poured, was obtained in the remainder by varying the length of the incision as follows:—

| | Length of Incision | Position | Result |
|---|---|---|---|
| 1 | ... 3 mms. | Upper fornix | No infection |
| 2 | ... 3 mms. | Lower fornix | No infection |
| 3 | ... 5 mms. | Lower fornix | Accidental keratitis |
| 4 | ... 5 mms. | Lateral fornix | No infection |
| 5 | ... 6 mms. | Lower fornix | Infection |
| 6 | ... 3.5 mms. | Lower fornix | No infection |
| 7 | Piece of wall of post. chamber excised | — | No infection |

These rabbits were kept for seven days. In one out of seven cases of prolapse, infection resulted and this was with the maximum length of scleral wound. All the controls in which the vitreous was deeply infected developed panophthalmitis.

It may be stated that the wounds of the sclera which usually are met with clinically, are more open than those experimentally produced by a three millimetre knife-wound. To obtain a wide exposure of vitreous, a piece of the wall of the posterior chamber of the eye was excised. Six eyes were taken and three controls done by injecting the same suspension of B. pyocyaneus 5 mms. into the vitreous. These produced inflammation and established the virulence of the strain of B. pyocyaneus used.

| No. | Size of piece of wall excised | Position | Vitreous loss | Result |
|---|---|---|---|---|
| 1 | ... 3 mms. by 1.5 mm. | Upper fornix | Yes | No infection |
| 2 | ... 2 mms. by 1.5 mm. | Outer fornix | Yes | No infection |
| 3 | ... 2 mms. by 2 mm. | Outer fornix | Slight | Infection |
| 4 | ... 3 mms. by 2 mms. | Lower fornix | Slight | No infection |
| 5 | ... 3 mms. by 2 mms. | Outer fornix | Slight | No infection |
| 6 | ... 3.5 mms. by 2 mms. | Lower fornix | Slight | No infection |

These rabbits were kept for seven days, and one in six became infected when there was an exceptionally wide exposure of vitreous to proved virulent micro-organisms. The position of the prolapse appeared to be immaterial and did not alter the resistance of the vitreous to infection. From the above experiments it can be stated that prolapsed vitreous does not readily become infected at least with the organism experimentally used. This is in conformity with the clinical observation already referred to. The

experimental conditions, the wide exposure of vitreous and the highly concentrated infective fluid constitute a more severe test than any condition which is likely to occur in clinical cases.

*Effect of Lacrimal Secretion.* The surface of prolapsed vitreous is exposed to the lacrimal secretion and it has been shown by Fleming that tears have a lytic effect on certain bacteria. So the growth of bacteria in vitreous was compared with that of vitreous to which 1/5 of its volume of tears had been added. This was estimated by the method previously described. The following counts were made:—

| | | *Vitreous + Lacrimal Secretion* | *Vitreous* |
|---|---|---|---|
| 1 | ... | 1088 millions per c.c. | 875 millions |
| 2 | ... | 950 millions per c.c. | average |
| 3 | ... | 1180 millions per c.c. | |

This showed that tears do not prevent the increase of bacteria.

*Mechanical Action of Lids and Tears.* In the above experiment it must be noted that the washing away effect was absent and the lacrimal secretion was not constantly renewed. To remedy this defect a number of rabbits (four) were taken and an incision through the conjunctiva down to the sclera was made. The flap was then dissected up for a distance of seven millimetres and a second incision made at this point into the posterior chamber through which vitreous prolapsed, forming a bead-like elevation. The flap was then allowed to relax and cover the prolapse. This prolapse was then injected with a suspension of B.pyocyaneus. Three control experiments were performed by injecting to a depth of 5 mms. into the vitreous the same suspension of B. pyocyaneus to prove its virulence. This was found to produce the typical inflammation. The result of the flap operations was absence of infection. Flaps were made in the outer and lower fornices. So no infection of the superficial layers of the vitreous resulted even when the action of the eyelids and of the tears was excluded.

*Serum and Bacterial Growth.*—The possible effect of serum on the growth of bacteria was investigated by comparison of the numbers obtained in vitreous to which the animal's serum had been added, but no appreciable difference was found.

*Influence of Trauma as a Predisposing Cause of Infection.*—The above experiment was repeated to estimate the effect of injection, using considerable pressure on the syringe piston, on the vitreous prolapse in half the cases.

Three controls were used where the needle containing a suspension of the same culture of B.pyocyaneus was introduced to a depth of 5 mms. Infection resulted.

No. of eyes where flap operation was done = nine.

*Results.*

| | | *Position* | *Result* | *Pressure used* |
|---|---|---|---|---|
| 1 | ... | Lower fornix | Infection | Yes |
| 2 | ... | Upper fornix | Infection | Yes |
| 3 | ... | Outer fornix | No infection | Yes |
| 4 | ... | Outer fornix | No infection | Yes |
| 5 | ... | Lower fornix | No infection | No |
| 6 | ... | Lateral fornix | No infection | No |
| 7 | ... | Lower fornix | No infection | No |
| 8 | ... | Lateral fornix | Infection | No |
| 9 | ... | Lateral fornix | No infection | No |

Three out of nine eyes, in which the prolapse was injected while covered with a conjunctival flap, became infected, of these two were cases where pressure had been used in making the injection. Counting the four eyes of the previous experiment, this gives three infected out of sixteen eyes.

In view of the two preceding experiments, it was resolved to produce the maximum damage while injecting the prolapsed vitreous, and at the same time to do the intra-ocular control with the minimal damage as hitherto. While all the control animals developed panophthalmitis, only two out of seven cases of prolapse became infected. These findings showed that with increased trauma there was an increased incidence of infection. If depth of penetration of the needle can be classed as trauma the next experiment was done to decide if this was also a factor. It was found that penetration of one millimetre depth resulted in no infection, depths of 1·5 mm. gave delay in the onset of the ensuing inflammation, while depths of 3 mms. resulted in panophthalmitis.

It seems, then, that shallow penetration of the vitreous is not likely to be followed by infection and although this means less trauma it is also placing the bacteria in closer apposition to the extremely vascular choroid. As mechanical action at the surface or lytic action of the tears could be excluded, as an explanation of the relative insusceptibility of the prolapsed vitreous to infection, the possible significance of phagocytosis was investigated.

*Lack of Histological Evidence of Phagocytosis.*—This was obtained from two sources; (1) a series of flap operations (12, 24, 36 hours) and (2) where the prolapse of vitreous was produced through a stab wound or a window was cut out of the walls of the posterior chamber. In addition a series of rabbits was taken and flap prolapses produced. They were killed from 48 hours onwards after the operation.

(1) In the first group the animals were killed at 12, 24 and 36 hours, so that any early emigration of phagocytic cells could be determined. In no case was there any leucocytic invasion of the vitreous, either of the prolapse or of the general vitreous body. At

the most there was some engorgement of the structures in the subconjunctival space surrounding the prolapse, probably from trauma.

(2) This gave a more detailed picture of the happenings at the site of the prolapse and the changes due to trauma. They are discussed under microscopic changes at the prolapse.

*Microscopic Changes at the Prolapse.*—Prolapse of vitreous was produced in the following ways:—(1) Through a stab wound where the scleral incision lies immediately below that of the conjunctiva, (2) where a piece of the sclerotic and other walls is cut out, (3) prolapse of vitreous through a stab wound beneath a conjunctival flap.

The trauma of these methods varied. It was least in the stab wounds and greatest where a flap of conjunctiva was dissected up and a prolapse of vitreous made beneath it.

In dealing with the microscopic appearances those effects due to trauma must be carefully set aside from the histological changes due to exposure of the vitreous to a suspension in saline of B.pyocyaneus. The main change resulting from trauma was the formation of a small haematoma which was absorbed in the usual way.

At the prolapse vitreous is seen spreading between the edges of the incision in the sclera and other coats of the eye to form a globular surface supported at its periphery by the edges of the cut conjunctiva. It is normal looking and quite free from cells. At its periphery are a few cells consisting of histiocytes and young fibroblasts. An occasional polymorphar leucocyte is seen. There were no changes in the choroid or ciliary body, a finding in marked contrast to that accompanying deep inoculation of the vitreous. In

Prolapse of Vitreous under a Flap.

the absence of bacteria as shown by negative results with Gram's staining, this reaction was almost entirely due to trauma associated with the operative procedure.

Exposure of vitreous to bacteria was not therefore accompanied by any phagocytic response which could be invoked to explain its immunity to infection. Although bacteria fail to obtain entry into the interior of the posterior chamber in a large percentage of cases in which vitreous is prolapsed through a scleral wound, they may be harboured on the surface of the exposed vitreous. An attempt to settle this point was made in two ways. First, in a series of rabbits in which a prolapse of vitreous under a conjunctival flap had been injected with B.pyocyaneus, the vitreous in the immediate neighbourhood of the flap was aspirated under sterile conditions by introducing the needle of a syringe through a puncture of the opposite side of the sclera. This was plated on to agar but no growth was obtained. Secondly, in another group of rabbits in which flap prolapsed vitreous had been exposed to infection, a large needle was passed through the opening in the sclera into the depths of the vitreous, in the hope that any bacteria might be carried into the interior of the vitreous. This resulted in negative findings. At the same times smears from the conjunctival sacs of these two sets of animals showed B.pyocyaneus in 40 per cent. of cases at the end of 24 hours, and 7 per cent. at the end of the third day. So although the micro-organisms persisted in the conjunctiva for some time there was no evidence of their penetration into the interior of the eye through the wound of the vitreous containing chamber.

## Discussion

It thus appears under experimental conditions in the rabbit as under conditions of clinical injury in man that the prolapsed vitreous has a considerable power of resisting infection which might lead to the destruction of the eyeball. The injection of even a very small quantity of a virulent pyogenic organism such as B.pyocyaneus to a depth of 5 mms. or more into the vitreous is almost invariably followed by a rapidly destructive suppuration of the eyeball. On the other hand it was difficult to produce infection by flooding the surface of a vitreous prolapse with the same bacteria even in great concentration. There seems little doubt that the vitreous provides a reasonably good culture medium for bacteria, and it is hard to understand why the spread of infection does not take place. It cannot be claimed that the foregoing experiments explain this difference in the result of superficial and deep inoculation, but certain possible explanations appear to have been eliminated. No significant bactericidal action of the tears or of the animal's serum could be demonstrated. Nor was it possible to consider that the mechanical

action of the eyelids or dilution and removal of the bacterial inoculum by tears, were responsible for the benign course of superficial prolapse. Bacteria in excess of those producing an invariable panophthalmitis on deeper inoculation could be introduced without effect into the surface of the prolapse while the latter was covered with a valve-like flap of conjunctiva. Although the position of the surface prolapse implies its close proximity to the vascular choroid, there was no histological evidence that phagocytosis of the inoculated bacteria played any significant part.

**Summary**

The remarkable resistance to destructive infection of the eyeball observed in cases of traumatic prolapse of the vitreous in man can be paralleled experimentally in rabbits using a highly virulent B.pyocyaneus as test organism. After exclusion of merely mechanical factors there still remains some significant difference in the resistance of the superficial and deeper layers of the vitreous.

My best thanks are due to Sir John Parsons for his continued interest in this work. To Professor C. C. Okell I am especially indebted for many valuable suggestions and for repeated help. Dr. G. R. Cameron has helped me with the histology.

The investigation was carried out in the bacteriological department of University College Medical School and the expenses were defrayed by a grant from the Medical Research Council.

## A CASE OF SEVERE SYMPATHETIC INFLAMMATION BROUGHT TO A SUCCESSFUL CONCLUSION

BY

J. HERBERT FISHER

LONDON

AS an encouragement to surgeons confronted with the results of severe sympathetic ophthalmitis the following record of a case of this character should not go unpublished. In 1919 a boy, A.E.F., born in 1908, was using a fork with which to bore a hole in a leather belt, when one of the prongs penetrated his right eye. About four or five weeks after the accident the surgeon in charge of the case removed the injured eye. When the patient left the Nursing Home, the left eye was slightly bloodshot and inflamed; drops were used to it and an ointment for local inunction in the neighbourhood of the orbit. He continued to see his

surgeon once a month for eighteen months, but the vision had progressively failed, and on April 22, 1921, two years after the accident, he came to me at Moorfields Eye Hospital for the first time. I found the eye very severely damaged by sympathetic inflammation. There was still some deep injection: much gross keratitis punctata, some of the spots of quite fantastic shape, was deposited on the back of the cornea. The tension was $-1\frac{1}{2}$, and the soft globe was squared by the pressure of the recti muscles. The iris was discoloured and the subject of total posterior synechia. The pupil was completely occluded by exudate of inflammatory origin organised on the lens capsule. The vision was only perception of light.

I admitted him as an In-patient and he remained in hospital for twelve weeks: during this time the eye was treated by applications of heat, atropine was used to it, and in all twelve small injections of N.A.B. and of kharsivan were administered. On May 23, 1921, the tension of the eye was measured with McLean's tonometer as less than 10.

On July 26, 1921, he was discharged with very little alteration in the condition of the eye: the tension was still very sub-normal, though perhaps a very little improved. The blood count, which at first had shown a considerable excess of large lymphocytes, had approached a little nearer to the normal.

For the next six months the patient used hot bathings, and a drop of atropine once daily to the eye, and took gr. i of hydrargyri c. creta internally, as a powder, twice a day in spells of a fortnight separated by three-week intervals.

For the next five years he obtained his education at the Worcester College for the Blind on sightless methods and using Braille. During this period I saw him occasionally at long intervals.

On September 12, 1922, I noted: "Tension still —, and globe squared: the eye flushes on examination: blood vessels from the atrophic iris extend over the adventitious capsule of organised exudate in which the degenerate lens is enclosed. The projection of light rather uncertain in the nasal part of the field."

On November 12, 1926, I readmitted him to Moorfields Hospital, and decided to make an attempt to recover some vision for him, though I was strongly advised by two of my colleagues, with whom I consulted, to leave matters alone as they adjudged any operative procedure on an eye so grossly disorganised by sympathetic inflammation to be quite hopeless.

At this time the vision was still, of course, only perception of light. The projection was fairly good in the temporal field but uncertain to the nasal side. The anterior chamber was shallow, but I thought the tension of the eye perhaps a little less sub-normal. The blood count was now reported to me as normal.

On November 13, 1926, I had a general anaesthetic administered and after making the usual cataract section endeavoured to do an iridectomy upwards: this was not attended by much success owing to the total posterior synechia of a very friable and atrophied iris. I next attempted to pass a scoop behind the lens, but was quite unable to accomplish this, being frustrated by the tough organised diaphragm of inflammatory origin which enclosed the lens both "fore and aft." I therefore slit peripherally into this adventitious capsule with the point of the Graefe knife introduced through the section I had made in the limbus, and following its line: on my doing this some grumous semi-solid cheesy-looking material exuded; but I was now able to pass one branch of a capsule forceps into the vitreous chamber, the other into the anterior chamber in front of the lens, and thus to grasp the lens between its teeth. With a sharp jerk I was at once successful in dragging out the lens and the fibrous material in which it was enclosed.

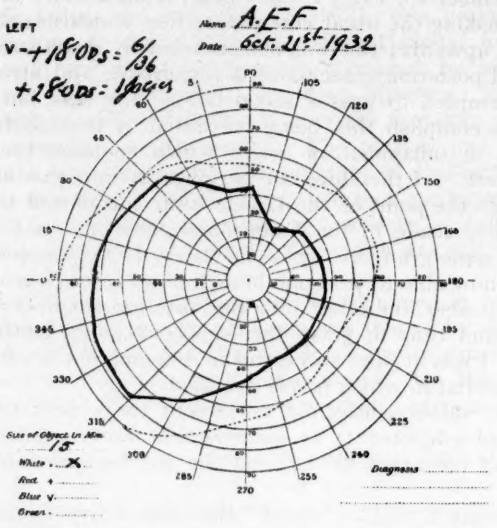
The eye, subsequently, did not resent the violent treatment to which I had subjected it; no unfavourable reaction followed though the upward coloboma closed, and the iris became completely updrawn.

On January 5, 1927, I noted "the conjunctiva flushes readily." No new precipitates: some appearance of a feathered hazy area in the lower part of the cornea suggests calcareous or hyaline degeneration. T. still minus. No reflex from fundus obtainable. V. = perception of light, best to the temporal side.

On May 5, 1927, I thought the projection was rather more reliable. On May 10, having again admitted him as an in-patient, after chloroform had been administered I performed an iridotomy with de Wecker's scissors, and left the eye with a centrally placed artificial pupil, which has permanently persisted and presents an appearance almost completely natural. At the first dressing after this, the final, operation, the patient was able to see a nurse moving at the foot of his bed. He left the hospital on May 28, 1927; he was then able to count fingers at 18 inches, and I could obtain a dull reflex through his artificial pupil.

A year later wearing +18·0 D. spherical he read 6/36, and by holding this lens remote from the eye he read 4 Jaeger. He was leading the life of a sighted man: guiding himself about without difficulty and enjoying cinemas where he could read the captions under the pictures.

On October 21, 1932, I last saw this patient. He is now a student in his second term at a Theological College, reading for Orders in the Church of England. He swims and rows, and plays ping-pong and billiards. I have warned him against any efforts which might conduce to a detachment of retina. The eye though still squared and of a tension of $-1$—$1\frac{1}{2}$, presents a good appearance




with a central pupil and nothing caught up. With a +18·0 D. spherical he sees 6/36, and with + 28·0 D. spherical 1 Jaeger fluently, though at a short range: no doubt the soft eye is flattened from before backwards, as well as squared laterally.

Ophthalmoscopic examination is difficult, owing to some corneal degeneration a very little gauzy obstruction in the pupil and some vitreous opacity, but an even red reflex is obtained from all parts of the fundus, and sufficient illumination is obtained to enable me to see dimly the optic disc and vessels in the retina. The very satisfactory field of vision, which is reproduced, was obtained on the perimeter with a 15 mm. test object.

There are a few points which I should like to emphasise:—

The first is, the extreme loyalty of this patient, and the confidence both of himself and of his mother that some day he would recover sight.

The second, that from the outset I had insisted that a long period of years must be allowed to elapse, during which the eye must lie fallow, before any operative procedure should be attempted, if indeed any such would ever be justifiable.

The third, that in the end this eye tolerated the violent interference, which alone could accomplish any useful results, without resentment. Indeed in this respect it proved as hardy as a syphilitic eye, but there was no doubt about the diagnosis and not the slightest suspicion or evidence of syphilis in the case.

# NEW LACRYMAL SAC RETRACTOR

BY

V. P. PATEL

KARACHI

THIS instrument was made for me by Messrs. Weiss & Son (London) in March, 1931, and differs from other models in the following respects:—

(*a*) The blades are a little longer and possess three blunt teeth instead of two. This additional one gives a better retraction of the skin incision and exposure of the area of operation.

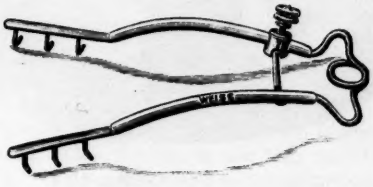
(*b*) The points are blunt and do not tear the atrophic skin of old patients.

(*c*) The difficulty of introducing the teeth of the retractor, which are larger than in other models, is obviated by undermining the skin incision.

(*d*) The shaft is curved to fit the contour of the face and not straight as in the other lacrymal sac retractors.

(*e*) A wider retraction of skin edges is possible and the degree of this can be regulated by a screw.

This instrument is also of use as a retractor in operations for removal of intra-orbital growths and cysts. I have used it in four



such cases with very great advantage; it saves an extra assistant to retract the skin.

I am indebted to Messrs. Weiss & Son for the loan of the block for printing.

# DOES TRAUMA FAVOUR THE OCCURRENCE OF THE ECHINOCOCCUS IN THE ORBIT?

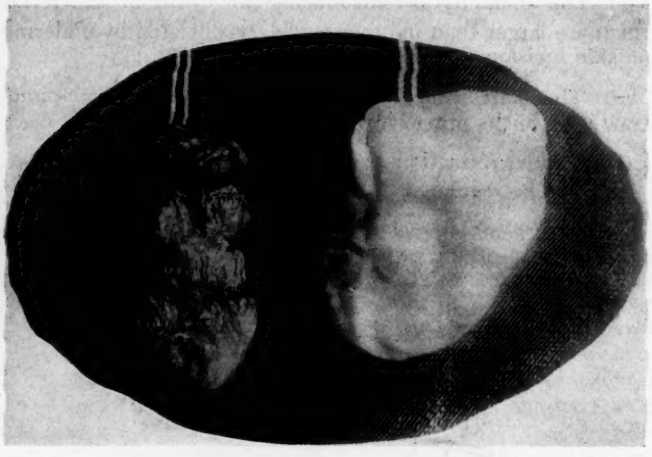
BY

V. P. PATEL

KARACHI

RECENTLY, in March, 1932, Dudinow reported a case of an "Echinococcus of the orbit and trauma" in *Klin. Monatsbl. f. Augenheilk.*, Vol. LXXXVIII, p. 373. His patient was a boy, aged 12 years, who developed a cyst of the left orbit following an injury by a donkey's kick.

I came across an exactly similar case in May, 1932. A Mohommedan boy, aged 12 years, came to the Mohatta Eye Hospital, Karachi, India, with a swelling of the size of a small orange, in the



No. I. *Tissue reaction cyst.* No. II. *Hydatid cyst.*

region of the right lower lid and cheek. The eyeball was pushed upwards and inwards and the lower corneal edge could be seen with difficulty. The boy's mother gave the history that the boy was kicked by a donkey six months previously, and since that date the swelling had gradually increased day by day. A clinical diagnosis of an intra-orbital cyst was made and on removal it was found to be an unilocular hydatid cyst.

As in Dudinow's case, trauma seems to have favoured the occurrence of the echinococcus in the orbit.

# A CASE OF DIABETIC RETINITIS

BY

A. B. ZORAB

SOUTHAMPTON

THE interest of this case lay entirely in the picture presented by the fundus oculi.

*C. P. A.*, aged 22 years, a young soldier, was admitted to the Royal Hampshire County Hospital, Winchester, on November 19, 1917, complaining of thirst and of passing large quantities of urine. The condition had been noticed for a month. He was found to have sugar in his urine. He was in the wards between November 19, 1917, and January 29, 1918. He was put on a carbohydrate-free diet and treated with sodii bicarb.; tr. camph. co. and codia at intervals. During his stay his urine was measured and tested daily. The quantity varied from 100 ozs. to 210 ozs. in the 24 hours, the sp. gr. varied between 130 and 140, and the sugar from 13 to 40 grs. per ounce. A blood count gave:—

| | |
|---|---|
| Reds ... ... ... | 3,000,000 |
| Whites ... ... ... | 15,000 |
| Polymorphs ... ... | 85 per cent. |
| Lymphocytes ... ... | 15 per cent. |

As far as his diabetes was concerned, when he left the hospital he was no better and no worse.

I was first asked to see him on November 28, 1917, as he had complained of slight mistiness of vision on reading. His vision was 6/6 in each eye, but in order to examine him fully I ordered that his pupils were to be dilated for my next visit the following week.

I quote the notes:—

December 5, 1917. Under homatropine. V. with +2·5 D. sph. =6/6 each eye. Fundus very suspicious of retinitis—shiny white exudate. Ord. +2·0 D. sph. I want to see this patient every week.

December 12, 1917. The retinae are oedematous and the vessels are coated with the usual whitish exudate. V. 6/9 to 6/12.

December 19, 1917. All the retinal vessels—even to the terminal twigs—are coated with a glistening white exudate filling up the sulcus between vessel and retina. The retinal condition is very unsatisfactory: oedematous but no haemorrhages. Vision is 6/6 each eye.

January 9, 1918. The retina itself has lost most of its oedema, but the discs are blurred. All the retinal vessels are white as though they contained chyle and not blood. They can be seen in their finest filaments which anastomose at the periphery. V =6/9 each eye.

*January* 14, 1918. The arteries and veins are still white and I have now been able to confirm the anastomoses of the smaller arteries in at least three positions in each eye—right at the periphery. The whiteness is less marked than it was last week.

*January* 23, 1918. The arteries and veins have lost their white appearance and consequently cannot be traced outwards very far. V.c +1·5 sph. =6/9 full each eye.*

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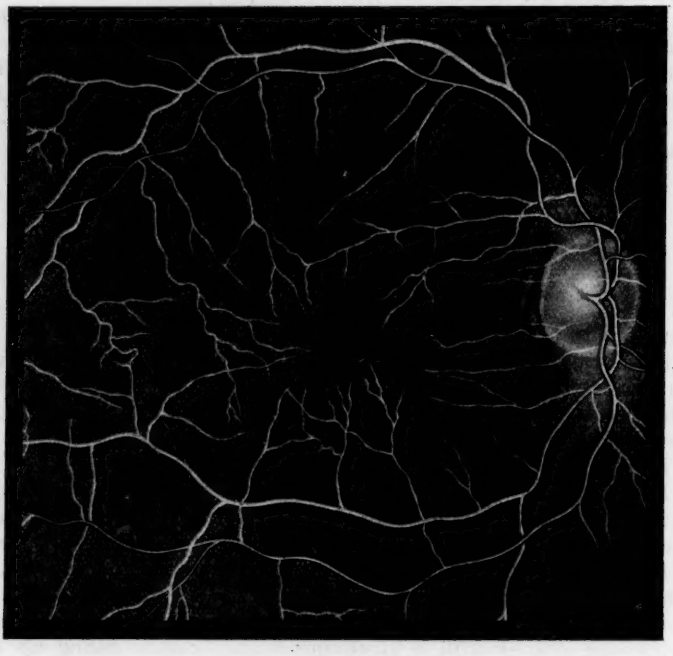
It is difficult to convey in words the very striking picture presented by the fundus in this case. The general reflex was the usual well-known crimson red, slightly blurred perhaps by the oedema of



the retina. Against this background the vessels showed up in a startling fashion silvery white, bright and distinct, even the smallest twigs could be seen quite easily by the direct method—the hypermetropia making it all the easier to focus on them. The pupils dilated very widely and the extreme periphery of the fundus could be seen. I could follow an artery from one of the main branches

* The notes and commentary were written in 1918.

of the central retinal, then to a smaller branch and so on till it broke up into a veritable net-work and could trace back a vein from this net-work to the main veins. In three separate parts of the fundus of each eye, I could see with absolute distinctness, beyond any possibility of mistake, an anastomosis between two small *arteries*. There were two such anastomoses between branches of the inferior and temporal retinal arteries and one such anastomosis between branches of the inferior and nasal retinal arteries.

I could find no such anastomosis in the upper half of the fundus in either eye. From first to last the media remained absolutely clear and I never could detect the smallest trace of a retinal haemorrhage at any period.

On referring to Fuchs' Text Book of Ophthalmology (fifth edition, pp. 580-581), I found the following:—"Very rarely in young diabetics, especially when nearing death, retinal lipaemia is found, *i.e.*, a condition in which on account of the large amount of fat in the blood, the retinal vessels appear reddish white or pure white." This statement is by Duane.

Such a condition was not found in the case described above. The blood examination failed to reveal any marked divergence from the normal, and its colour, when drawn from a pricked finger, was quite satisfactory. Further, the filling in of the sulcus between the walls of the larger vessels and the retina showed the presence of an exudative coating.

## ANNOTATION

### Blindness in Trinidad and Tobago

A valuable attempt, admittedly incomplete, has been made by Mr. Métevier towards the correct estimation and prophylaxis of blindness in Trinidad and Tobago. As a foundation for further work in these islands the report, which will be laid before the Legislative Council, is admirable, and some interesting facts are recorded in it. In this colony the question as to whether a person is blind or not has up to the present been largely decided by the Committee of the Institute for the Blind. The granting of Poor Relief last year has brought the condition of economic blindness in some cases of unemployment and indigence before the Inspector for Poor Relief. No further state action for dealing specifically with the blind has been taken; but, acting on the suggestion of Mr. and Mrs. Holt Mather, of New York, the Committee of the Institute of the Blind has had under consideration the preparation of a census of the blind in this colony. Mr. Métevier has examined the cases in the various institutions, and has added details of 53 patients seen in private between January 1, 1931 and April 30, 1932.

The population of Trinidad and Tobago in 1931 amounted to 412,783, of whom 823 were blind, giving a figure of 199·3 per 100,000. Tobago, in the same year, with a population of 25,352, had 56 blind persons.

The state census has, up till now, given too low a figure for the blind in this colony. Thus in 1931 the blind returns in the census for inmates of the House of Refuge were 34: (male 23, females 11). Mr. Métevier's examination of the inmates disclosed a figure of 63, with 41 males, and 22 females. The same under-estimation is apparent in the figures for the leper settlement; 10 blind according to the census returns, and 15 in those of Métevier.

The definition of blindness in this report is that of the Blind Persons' Act 1920 of this country for adults; and in the case of children, if a child's sight is so defective that he or she cannot read the ordinary school books without danger to sight, that child may be regarded as blind for educational purposes.

Of the 15 blind lepers, the blindness in every case but one was directly due to leprosy. The one exception was due to uncomplicated senile cataract in the only remaining percipient eye, the other being blind from complications of anaesthetic leprosy. This case is suitable for operation, and Métevier notes that lepers are reported to stand eye operations very well.

The figures of 194 cases of blindness which form the basis of this report give the following diseases among the important causes: syphilis, 45 cases; primary glaucoma, 38; primary senile cataract, 20; adult ophthalmia, 11; ophthalmia neonatorum, 4; congenital cases, 5; leprosy, 14; the rest, 57. Thus syphilis and glaucoma are a predominant factor in this colony; focal sepsis and vitamin deficiency are aggravating factors; trachoma has not been found to be a cause of blindness, and occupational causes are practically non-existant; no cases of blindness due to myopia have been recorded. The figures for ophthalmia neonatorum are low, but those of purulent ophthalmia of adults are higher than one would have expected. The subject of optic nerve disease is important and demands further investigation. An unusual series of cases occurring in five members of a family has been noted. The census figures for 1931 show an increase in blindness of 46 per 100,000 of total population; when compared with those of 1921.

The author is insistent on the need for prophylaxis and the system of registration which obtains in Great Britain. An educational campaign is one method of inducing people to seek medical advice, for the rustic of Trinidad apparently has a fervid belief in the efficacy of simple lotions for glaucoma, and after weeks of such treatment may possibly visit an optician.

It is to be hoped that ophthalmic surgeons who practise in other Crown Colonies will copy Mr. Métevier in his task, and thus lead to a general amelioration of the figures for the blind population of the Empire. The author deserves unstinted praise for his work.

# ABSTRACTS

## I.—GLAUCOMA

(1) **Federici (Naples).—The clinical value of the caffein test as a means of early diagnosis of chronic glaucoma. (Sul valore clinico della prova della caffeina per la diagnosi precoce del glaucoma cronico semplice).** *Boll. d'Ocul.*, July, 1932.

(1) The early diagnosis of chronic glaucoma is a matter of difficulty and no means should be neglected to assist in making a true finding. It has been suggested that the change in intra-ocular tension which follows the subcutaneous injection of caffein might be used as a means of diagnosis. **Federici** has tested this in a number of cases and concludes that it has little diagnostic value and may even be dangerous on account of the increase in blood pressure which not infrequently follows.

HAROLD GRIMSDALE.

(2) **Friedenwald, Jonas S. (Baltimore).—Some factors concerned in the success of operations for glaucoma.** *Amer. Jl. of Ophthal.*, March, 1932.

(2) **Friedenwald** gives an interesting justification in this article for pre-operative retro-orbital injection of adrenalin. Briefly the argument is this:—In the normal eye, the intra-ocular capillary pressure exceeds the intra-ocular pressure by some 20-30 mm. Hg. The walls of the capillaries are able to sustain this pressure, and hold back the protein content of the blood plasma. When the anterior chamber is evacuated, the pressure on the capillary walls is suddenly increased by an amount equal to the pre-existing intra-ocular pressure and brings about the passage of protein molecules and the occurrence of oedema, particularly in the ciliary body. As a result of this, the intra-ocular pressure after simple puncture of the cornea may rise to a height greater than it was before operation. Duke-Elder has shown that if adrenalin be injected retro-orbitally, the aqueous formed after puncture of the anterior chamber contains a percentage of protein which is only slightly above the normal concentration. This is borne out clinically by some experiments the author made on dogs, in which he found that the previous injection with adrenalin abolished the secondary rise of intra-ocular pressure after drainage of the anterior chamber and also caused a much more gradual restoration of the intra-ocular pressure to normal. In the human being 1 c.c. of 1 per cent. novocaine is mixed with 0.2—0.3 c.c. of 1/1,000 adrenalin and injected retro-orbitally, the needle being passed through the lower lid near the inferior temporal angle of the

orbit. The operation is begun between five and ten minutes after the injection. The only contra-indications are severe hypertension or advanced arterial disease.

F. A. W-N.

(3) **Marlow, S. B. (Syracuse, N.Y.).—Visual fields in chronic glaucoma. The effect of reduced illumination.** *Arch. of Ophthal.*, February, 1932.

(3) **Marlow** finds that the effect of reducing the illumination of the tangent screen when examining cases of chronic glaucoma, increases the sensitiveness of the test. His method is to reduce the illumination to about 0.2 foot candles and after allowing time for adaptation to take place, to plot the patient's field with a 1 mm. object at a distance of 1 metre. In this way, he was able to demonstrate in one case a sickle-shaped scotoma and in another, a nasal step which was not evident in light of ordinary intensity. In the discussion of his paper, Luther Peter pointed out that the reduction of the light sense in glaucoma would account for the field defects and Mark Schoenberg suggested the employment of dark glasses instead of reduced illumination.

F. A. W-N.

## II.—RETINA

(1) **Gonin, J. (Lausanne).—Thermo-puncture or chemical cauterisation in the treatment of detachment of the retina. (Thermoponctions ou cautérisations chimiques dans le traitement du décollement rétinien).** *Arch. d'Ophtal.*, May, 1932.

(1) In this article, after a reference to criticisms by some of his professional brethren, **Gonin** discusses at some length the relative merits of the two methods of treatment indicated in the title, and concludes by a brief statement of his opinion thereon.

The idea of creating choroido-retinal adhesions by chemical irritants applied to the outer surface of the choroid, after exposure by scleral trephining, occurred to the author in 1921, as being less dangerous than Schoeler's plan of injecting tincture of iodine. As a result of experiments on rabbits Guist concluded that potash, in the form of a pencil, is preferable to other caustics, and that it may be applied to the choroid without untoward results was shown by Guist and Lindner.

Gonin originally employed the thermo-cautery because it seemed an easy matter to limit its application to the desired spot, and because it proved capable of creating adhesions between the vitreous,

retina, choroid and sclera, sufficiently firm to resist the traction of the vitreous which, in his opinion, is the usual if not invariable cause of the retinal rent. He adopted this method in a sufficient number of cases to determine its potentialities. In three consecutive series of 100, he decided that the use of the thermo-cautery was advisable in 221 of the 300 cases. Complete recovery was obtained in approximately 40 per cent., generally by one cauterisation. In 103 cases some improvement ensued, and 78 cases were unsuccessful.

Gonin asks:—Would cauterisation by potash have shown any definite advantage in the cases cured by the other method; would it have given better results in the unsuccessful cases, or have increased the chances of success in conditions which appeared to contra-indicate the use of the thermo-cautery? He expresses great doubt that the operative failures which he has recorded are attributable, at least in the majority of them, to the method of operating.

Lindner has alleged that the thermo-cautery produces a condition allied to necrosis in the adjoining part of the retina, leading frequently to secondary rents; and also that it induces a shortening of the retina which results in traction towards the cicatrix. Gonin's experience is that the first complication is very exceptional and occurs only in conditions which appear to be independent of the cauterisation. In nearly 500 cases treated by the Paquelin cautery, not more than ten showed a secondary retinal tear. He has not had a single instance of traction on the retina after the retina has become well applied to the choroid. Folds radiating from the cicatrix result from imperfect re-application.

Haemorrhage from the choroid following thermo-puncture is, as the author pointed out long since, the chief complication to dread. If chemical cauterisation minimises or avoids this danger it will prove a notable advantage of this method.

Large or multiple retinal rents call for more thermo-punctures than can be made at one sitting. Here chemical caustics will prove preferable, as also in cases in which the site of the rent cannot be precisely determined.

The author's view is that, at present, the treatment of retinal detachment by chemical cauterisation cannot supplant that by thermo-cauterisation, but that it may prove a valuable alternative in cases in which the application of the thermo-cautery is difficult. When a rent in the retina can be obliterated by one, or if necessary two, thermo-punctures it would be unjustifiable to abandon this procedure for one much more difficult of application. On the other hand, when it is desirable to establish a long line of barrage in relation to rents difficult to localise or to surround a large rent by a semicircle of adhesions, failing which it would be impossible to make any attempt towards cure, no operator should hesitate to adopt the Guist-Lindner method until some simpler procedure, attaining similar results, is brought forward.

J. B. LAWFORD.

(2) **Veil, P., Dollfus, M. A., Bousseau, M. (Paris).—The results of obliterating thermo-puncture (Gonin's method) in detachment of the retina. (Les résultats de la thermoponction oblitérante de Gonin dans le décollement de la rétine).** *Arch. d'Ophtal.*, May, 1932.

(2) Reports of the treatment of detachment of the retina by Gonin's method are now numerous, but further records are desirable, especially of cases observed over a prolonged period. Information on the question of recurrence of detachment is also important.

In a previous communication (*Arch. d'Ophtal.*, June, 1931,) **Veil and Dollfus** recorded 11 cases: they now report their further experience. Clinical notes with numerous charts of fields of vision, of the hitherto unreported examples, are given, followed by a summary of the results.

Of 32 cases operated upon, 14, *i.e.*, 43.7 per cent, were "completely cured." Four of these were under observation over 12 months. Including the cases of "amelioration" the positive results equalled 39.3 per cent. In 10 cases, only one thermo-puncture was required; in three instances 2, and in one instance 3 applications were necessary. These repeated interventions were called for in patients in whom a large rent or multiple rents had occurred. Thirteen of the 14 cases were myopic. In no instance was recurrence of detachment noted: in this respect the writers' experience has been more fortunate than that of some earlier observers. The cases in which the operative prognosis is least favourable are those with a large retinal rent, multiple rents or hypertonus.

J. B. LAWFORD.

## III.—MISCELLANEOUS

(1) **Bulson (Indiana, U.S.A.).—Choked disc (papilloedema) due to disease of the sphenoidal sinus.** *Jl. Amer. Med. Assoc.*, September 26, 1931.

(1) **Bulson** reports the case of a lady who had noticed blurring of the vision in one eye, the left, 11 days previous to the first consultation. During the last three days the vision had depreciated to counting fingers on the temporal side only. The pupil was dilated and sluggish in reaction to light. Ophthalmoscopically there was swelling of the nerve head estimated at between 3 and 4 dioptres, with marked turgescence of the veins, blurring of the disc margins, and a few punctate haemorrhages on the disc. X-ray examination showed marked dullness of the left sphenoidal sinus. The left sphenoidal sinus was opened and found to be completely filled with pus, which seemed to be under pressure. Two days

after the operation the turgescence of the nerve head had considerably diminished. Three weeks after the operation the vision had returned to normal, and this was retained during the next five years while she was under observation.

The author reports the case because statements, which he instances, have been made that suppurative processes in the posterior paranasal sinuses cannot produce papilloedema.

A. F. MACCALLAN.

(2) **Doherty and Trubek (New York).—Significant haemorrhagic lesions in bacterial endocarditis (Roth's Spots).** *Jl. Amer. Med. Assoc.*, August 1, 1931.

(2) **Doherty** and **Trubek** had opportunities of examining the fundi of ten cases of sub-acute bacterial endocarditis, in two of which their observations were important in arriving at a diagnosis of the conditions. This disease is of unusual interest to physicians because of the variety of constitutional symptoms and changes which it presents. Early recognition is often difficult even by those familiar with its manifestations, and one must search closely for the remarkable phenomena which may give a clue to the diagnosis. The embolic phenomena resulting from pieces of the vegetations or, perhaps, from clumps of the bacteria themselves lodging within vessels in the viscera, skin or mucous membranes, are particularly important in the differential diagnosis. The finding of the retinal lesion is of considerable value when the cutaneous petechiae are few or not distinctive, because of the presence of other varieties of skin lesions.

The daily examination of the fundus may at any time reward the persistent observer with a retinal lesion which often makes its appearance between examinations and may be quite transitory, often completely vanishing within a few days. The authors have encountered a variety of retinal lesions in this disease but the one which they consider as particularly pathognomonic is that which they have termed a "canoe-shaped" linear haemorrhagic spot with a light central area appearing most often from 1 to 2 disc diameters away from the nerve head but at times only in the periphery. The lesion appears in the most superficial portion of the nerve fibre layer; its shape is dependent on the arrangement of the fibres of this layer, the long axis of the haemorrhage coinciding with the direction of the emerging fibres.

These retinal lesions were described by von Roth in 1872 and again by Litten in 1902, and are reported in Marcus Gunn's edition of Gowers's Medical Ophthalmoscopy (Churchill, 1904) where as good a description as that given in the paper under review will be found.

A. F. MACCALLAN.

(3) **Whalman, H. F. (Los Angeles).—Typhoid—paratyphoid vaccine in ocular inflammations.** *California and West. Med.*, p. 428, December, 1931.

(3) As a form of protein shock treatment **Whalman** reports the value of intravenous administration of typhoid-paratyphoid vaccine. The adult dose given was 25,000,000 organisms and though this produced typical systemic reaction any focal reaction was absent or practically so.

Many forms of inflammation of all parts of the eye were treated with favourable results—in some cases after much other treatment had produced no improvement. It is pointed out that local treatment and the elimination of foci of infection must be carried out as usual.

R. C. DAVENPORT.

(4) **Cecchetto and Papagno (Verona).—A note on the causation of traumatic holes at the macula. (Contributo etiologico delle perforazioni della regione maculare da trauma).** *Ann. di Ottal.*, January, 1932.

(4) **Cecchetto** and **Papagno** report a case in which a severe blow on the right upper orbital margin was followed immediately by great reduction of vision of the right eye. There was, when the patient was seen, a contused and lacerated wound at the junction of the outer and middle thirds of the orbital margin; the fundus showed a haemorrhage covering the fovea; when this absorbed, a typical "hole" was visible. The authors regard this case as of more than usual interest since it shows that an indirect injury is able to produce in some cases, a hole at the macula.

(A similar cause was recorded in one of the cases which were collected by Ogilvie and published in a paper in 1900 in the Transactions of the Ophthalmological Society, U.K. The authors, who add a considerable list of previous investigators, do not seem to be acquainted with this paper.)

HAROLD GRIMSDALE.

(5) **Santonastaso (Bari).—Ocular changes in leprosy. (Alterazioni oculari nella lebbra).** *Ann. di Ottal.*, September-October-November-December, 1931, January, 1932.

(5) In this long paper **Santonastaso** gives a detailed account of the various forms in which leprosy may attack the eye. Since blindness is comparatively common in the first years of the disease, it is important to recognize ocular symptoms early in order that treatment may be begun promptly.

Leprosy is so rare in this country that few ophthalmic surgeons have seen cases, but this paper which is fully illustrated, is a mine of information on the subject.

HAROLD GRIMSDALE.

(6) **Laricchia (Bari).—Ocular complications of deaf-mutism. (Alterazioni oculari nel sordomutismo).** *Ann. di Ottal.*, January, 1932.

(6) **Laricchia** has examined thoroughly 150 deaf-mutes. Beyond errors of refraction, he has observed various changes in the fundus; optic atrophy, retinitis pigmentosa, disturbance of retinal pigment, etc.: "the visual fields," the light and the colour sense showed no "abnormality worthy of note." Having regard to the finding of retinitis pigmentosa, this last statement is rather astonishing.

HAROLD GRIMSDALE.

(7) **Ronchi (Florence).—Visual acuity. (Sull'acuita visuale).** *Boll. d'Ocul.*, March, 1932.

(7) The value of visual acuity is purely experimental; it is not possible to correlate the power of resolution of the eye with the anatomical arrangement of the cones at the macula. Vision is not simply the formation of an image on the retina; there are many other psychological factors, varying with the individual, which make it impossible to formulate purely physiological laws for its estimation.

HAROLD GRIMSDALE.

(8) **Leonardi (Rome).—Removal of non-magnetic foreign bodies from the anterior chamber. (L'estrazione di corpi non magnetizzabili dalla camera anteriore).** *Boll. d'Ocul.*, May, 1932.

(8) **Leonardi** points out the difficulty of removing foreign bodies which are lying in the angle of the chamber by the usual incision unless an iridectomy is performed at the same time, and to save the eye this mutilation he suggests the following method. He makes with a keratome a very small opening at the limbus, allows the aqueous to escape very gradually, and then enlarges the opening by repeated small cuts with a Graefe's knife. In this way he divides about a third of the circumference. Then lifting up the flap in a pair of forceps, he lays bare the surface of the iris and can remove the foreign body.

HAROLD GRIMSDALE.

(9) **Favaloro (Catania).—The value of exploratory puncture in cases of neoplasm of the eye or orbit. (Sull'importanza diagnostica della punctura esplorativa nelle affezionineoplastiche dell'occhio e dell'orbita).** *Boll. d'Ocul.*, May, 1932.

(9) **Favaloro** recommends the use of exploratory puncture in cases where orbital tumour is suspected. He finds that the needle

gives valuable information as to the size and consistency, and also as to the exact seat of the neoplasm. Using a needle with lumen 1 mm. in diameter, he is able to withdraw small fragments of the growth which may be examined microscopically to give information about the histological nature of the mass.

It is important to use a long needle, at least 50 mm. long, or the surgeon will be unable to reach the deeper part of the orbit.

Favaloro strongly recommends trans-scleral puncture in cases of suspected intra-ocular tumour. The withdrawal of some fluid from the aqueous or vitreous will sometimes give material in which the elements of the neoplasm may be recognized. He thinks the risk of metastasis by implantation has been exaggerated.

HAROLD GRIMSDALE.

(10) **Horniker and Salom (Trieste).—Ocular changes in tuberous sclerosis. (Alterazioni nella sclerosi tuberosa).** *Boll. d'Ocul.*, May, 1932.

(10) **Horniker** and **Salom** describe the ocular findings in four subjects of this disease. They rarely come under the notice of ophthalmic surgeons, since the patients are, from the cerebral lesions, of feeble mind. One of the patients died, and the eye grounds were examined microscopically. The masses on the disc and in the retina resembled, in structure, the patches in the brain. The authors draw attention to the part played by the vessels in the production of the appearance, and compare the condition with that found in Lindau's disease.

HAROLD GRIMSDALE.

(11) **Sondermann, R. (Berlin).—On the development of the anterior chamber and the corneal endothelium. (Beitrag zur Entwickelungsgeschichte der Vorderkammer und des Hornhautendothels).** *Arch. of Ophthal.*, Vol. CXXV, p. 407.

(11) According to **Sondermann** the corneal endothelium is of ectodermal origin, and not mesodermal, as has been hitherto supposed.

The thickened surface ectoderm, lying in front of the lens vesicle, is invaded by scleral fibres which split it into two layers, so that these fibres are lined on both sides by epithelial cells; and it is from those cells lying on their inner side that the endothelium arises.

The formation of the anterior chamber begins in the periphery in connection with the development of the pupillary membrane, which usually commences about the end of the second month or the beginning of the third.

The aqueous fluid arises by filtration from the relatively wide capillaries of the tissue lying in front of the rim of the optic cup, and of the pupillary membrane.

The filtration is brought about by the gradually increasing pressure exerted by the sclera (as it undergoes more and more condensation) on the vena irido-scleralis in its passage through this layer, whereby the flow of blood is obstructed and the pressure within the vein is abnormally raised.

The formation of the anterior chamber and the pupillary membrane may not infrequently be delayed very considerably, even for several months.

THOS. SNOWBALL.

(12) **Rossi (Modena).—The relation of primary glaucoma to the organic constitution. (Glaucoma primario e costituzione organica).** *Arch. di Ottal.*, January and February, 1932.

(12) In this long paper **Rossi** develops the thesis that glaucoma is not merely a local disease but depends on the condition of the whole organism. The older ophthalmic surgeons often regarded glaucoma as a manifestation of gout or some other diathesis. This view, in Rossi's opinion, has more truth in it than the modern mechanical theory, or the theory which explains the affection by the supposed disturbance of the action of one or more endocrine glands.

The subject is discussed under several heads; after dealing with the factors of race, sex and age, the question of hereditary influence is taken up; there is some evidence that glaucoma tends to run in families, but there is nothing to show whether this is the expression of some anatomical abnormality, or whether it denotes some inherited disturbance of function. Individual biochemistry is too complicated a matter to allow us to select some one endocrine gland as causing by its faulty metabolism, pathological variations of the intra-ocular pressure. The body must be regarded as a whole. Rossi has made anthropological measurements of a number of glaucoma patients with the object of discovering whether any special type is more liable to glaucoma than another.

He concludes that the glaucoma patient corresponds nearly to the brachy-cephalic alpine race, and that this type is specially prone to glaucoma.

The brachytypes, as against the longitypes, at a certain period of life, that is to say when old age is beginning, with the special disturbances of all circulatory and other systems, with alterations in the exchange of water, and in the vascular tension, tend to show the premonitary signs of glaucoma.

HAROLD GRIMSDALE.

## BOOK NOTICES

**Kurzes Handbuch der Ophthalmologie.** Band 7. Berlin: Julius Springer. 1932. Price, R.M. 160.

The seventh volume of the *Kurzes Handbuch der Ophthalmologie* is probably the most valuable of the series, dealing as it does with subjects which are rarely dealt with in full in the usual type of text-book. The first section, which is contributed by Professor Lichtwitz, of Berlin, deals with disorders of metabolism as they affect the eyes. The subject is treated very fully, especial attention being given to diabetes and gout. This is followed by a section on circulatory diseases written by Professor Kümmell, of Hamburg, which includes not only the usual degenerations such as arterio-sclerosis, and the blood diseases such as anaemia, leucaemia, polycythaemia, and so on, but deals also with changes in the blood vessels in tubercle, syphilis, and other diseases; moreover the influence of circulatory factors on glaucoma and cataract, and other ocular conditions is considered. A special section follows by Professor Igersheimer, of Frankfurt, on tuberculosis of the eye, which is comprehensively detailed and sound in its teaching, steering a middle course between the view which credits all nondescript inflammations of the eye with a tuberculous origin and that which denies the existence of non-specific tuberculo-toxic conditions. The methods of infection, both clinical and experimental are dealt with, and this is followed by a discussion on the pathology, diagnosis, and treatment of all forms of tuberculosis as they occur in the eye. A subsequent section planned on similar lines, and written by the same authority, deals with syphilis and its ocular complications. The next section of the volume, which is written by Professor Zade, of Heidelberg, deals with the ocular complications of infectious diseases—the acute fevers, rheumatism, skin diseases, septicaemic infections, respiratory diseases, and so on. A further section on intoxications follows, written by Professor Sattler, of Königsberg, which deals specially with the toxic amblyopias, and the effect of poisons on the eye, as well as auto-intoxications and the results of inverted and deficient metabolism, such as avitaminosis. The next section deals with the skin diseases which affect the eye, and is extremely detailed, comprising the various types of inflammatory conditions of the lids and face, congenital deformities of the skin as they affect the lids, hyperplasias, tumours, and so on. It is written by Professor Lutz, of Bâle. A short section, by Professor Zondek, of Berlin, follows on Graves' disease; and thereafter comes a full discussion of the problems of immunity as they affect the eye, which is contributed jointly by Professor Dold, of Kiel, and Professor Schieck, of

Würzburg. In this latter the whole general theory of immunity is dealt with, the various immunological reactions in the diseases which occur in ophthalmological practice, the specific reactions in such diseases as tubercle, syphilis, and so on, and the methods of immunization against these diseases. This is followed by a section dealing with the immunological reactions of the various tissues of the eye, and a discussion as to the mechanism of their resistance and reaction to infections. In this latter part the various inflammatory diseases which are anaphylactic in origin, such as types of conjunctivitis, keratitis, irido-cyclitis, are noticed. A further section deals with tropical ophthalmology, which is contributed by Professor Bakker, of Hilversum, wherein an immense amount of information is compressed within 120 pages. This is followed by several sections on therapeutics. The first of these by Professor Frey, of Göttingen, deals with ophthalmological pharmacology, the physiological action of drugs on the various structures of the eye, and their effect in pathological conditions. This is followed by a discussion on chemotherapy by Professor Steidle, of Würzburg, wherein after a general discussion, the specific action of such drugs as quinine, optochin, salvarsan, and others, and of the various metals, such as gold, bismuth, mercury, and zinc, are discussed. A further section on physico-therapy is written by Professor Comberg, of Berlin. This includes mechanical procedures such as massage, thermo-therapy, including the application of heat and diathermy, electric therapy, ionization, and radio-therapy, which includes treatment by ultra-violet light, X-ray, and radium. The final section of the book by Professor Lenz, of Breslau, deals with the general hygiene of the eye, and the treatment of the blind.

The whole forms an extremely comprehensive volume, well written, authoritative, provided with considerable literature, and excellently published.

**Ofthalmologicky Sbornik.** Papers read before the 7th Congress of the Czechoslovak Ophthalmological Society. Published by the Society, Prague, 1932.

The volume of *Transactions* for 1932, bears witness to the continued activity of the ophthalmologists in Czechoslovakia. It contains thirty-eight communications which, as heretofore, are rendered serviceable to readers outside Czechoslovakia, by brief summaries in French, English and German.

The papers traverse a wide range of subjects, but it is scarcely possible to obtain an estimate of their respective values by perusal of the *résumés*. Some of the latter are clearly indicative of merit and interest in the papers to which they refer. Disease of the anterior portion of the uveal tract has attracted most attention ;

there are thirteen communications containing the results of investigations concerning the aetiology (with statistical tables), the means of diagnosis and the modern methods of treatment of iritis and irido-cyclitis in its various forms. Tubercle as a cause heads the list, syphilis being next in frequency.

We note with pleasure that this volume is more freely illustrated than its predecessors. The illustrations, clinical and histological, are well reproduced in black and white.

**Sixth Annual Report of the Giza Memorial Ophthalmic Laboratory, 1931.** Department of Public Health, Cairo.

This report contains a record of the work carried on during 1931 at the laboratory adjoining the Giza Ophthalmic Hospital and also a number of original articles of great interest. Some of the latter will be referred to elsewhere in this Journal. Two post-graduate courses in ophthalmology are held each year, each occupying one month, the second being a corollary of the first. They are held for medical men who desire to obtain positions in the ophthalmic section of the Public Health Department. The two courses are followed by examinations, a primary and a secondary. Candidates are admitted to the primary examination after six months clinical training in whole time ophthalmology at one of the Egyptian Ophthalmic Hospitals, and to the final examination after a year's whole time work. A high standard of efficiency is demanded and 45 per cent. of the candidates failed to reach it.

The work of the laboratory included 1,650 bacteriological examinations and 700 microscopical examinations of sections. A large amount of the diagnostic bacteriological work is carried out locally at the various ophthalmic hospitals, at each of which laboratory facilities are available. As an instance of the richness of the material available at the laboratory it may be mentioned that 17 malignant tumours of the limbus were subjected to microscopical examination.

The author of the report is Dr. Rowland Wilson who has had the assistance of Major F. H. Stewart, D.Sc., M.D., as pathologist. The main cause of blindness in Egypt is the supervention of acute ophthalmias in the chronic trachomatous condition which is all prevalent. This has always been recognised in the annual reports of the Egyptian Ophthalmic Hospitals during the last 25 years. If Dr. Wilson refers to the report for 1912 he will read "Trachoma alone is an infrequent cause of blindness" on p. 10. He may therefore revise his erroneous deductions from these reports, in which trachoma, ***per se***, has never been adduced as a cause of blindness.

Dr. Wilson and Major Stewart are to be congratulated on having the opportunity to carry out such interesting work and on their success in dealing with it.

# OBITUARY

## ERNEST CLARKE, C.V.O.

WE regret to announce the death on November 22, at the age of 75, of Mr. Ernest Clarke, the Chairman of the Board of Directors of this Journal.

He was the elder son of Mr. Henry Clarke, J.P., of Cannon Hall, Hampstead, and was born on July 21, 1857. He was educated at University College School, St. Bartholomew's Hospital, and Downing College, Cambridge. His medical degrees were obtained at the University of London, the M.B. in 1881, and the M.D. in 1885. The M.R.C.S. he obtained in 1880.

He was House Surgeon and Assistant Administrator of Anaesthetics at St. Bartholomew's Hospital for 18 months (1881/82) and his first publication dates from this period. It was a contribution to the Abernethian Society in February, 1882, and is "a review of the Anaesthetics administered at St. Bartholomew's for the years 1875 to 1881." This paper shows the lucidity of argument and clearness of expression which characterise his later publications.

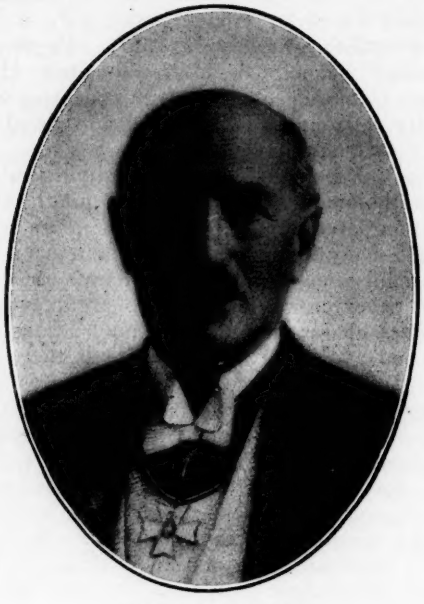
After this period at St. Bartholomew's he settled in Blackheath and soon obtained a large practice, but he had always been attracted by ophthalmology. In 1883 he was elected Surgeon to the Central London Ophthalmic Hospital, and in 1886 Surgeon, and later Ophthalmic Surgeon to the Miller General Hospital. He then determined to devote himself entirely to Ophthalmology, and, relinquishing his practice in Blackheath, he came to Chandos Street and commenced a singularly successful career. He furnished very material help in the foundation of the Freemasons' Hospital, and became its first Ophthalmic Surgeon. In 1894 he obtained the F.R.C.S.(Eng.).

He resumed relations with Downing College in 1904 and in 1928, was elected to an Honorary Fellowship. During the whole of this latter period he took a great interest in Downing, to which he was a frequent and generous benefactor. It must suffice here to mention the gift of an Exhibition for three years, the Organ which he has left for the new College Chapel, and is now in the Hall, generous contributions to the Building, and handsome gifts of plate to the College Associatoin, of which he had been President, the Boat Club and the Griffins Club, of which he was an Honorary Member.

He became a member of the Ophthalmological Society of the United Kingdom in 1885, was a member of its Council in 1893-6 and a Vice-President, 1910-12. He was a Fellow of the Royal Medical and Chirurgical Society from 1882 to 1907, and after the

Amalgamation, a Fellow of the Royal Society of Medicine to the date of his death. He was a member of the Council of the Section of Ophthalmology of the Royal Society of Medicine, 1913-1916, a Vice-President, 1925-1926, President of the Section, 1926-1928. He contributed much to both Ophthalmological Societies.

In 1892 appeared his first small book on "Eyestrain (commonly called Asthenopia)." This showed the tendency towards which his



ERNEST CLARKE*

work in Ophthalmology was leading him. He had always been a student and great admirer of the work of Donders, incidentally he was a first rate Dutch scholar, and in 1903 appeared the first edition of his book "The Errors of Accommodation and Refraction of the Eye." This book met with immediate success and ran through many editions, becoming the standard work on this subject. The fifth edition appeared in 1924, and was reprinted in 1929. He wrote the article on "Treatment of Errors of Refraction" in the Latham-English System of Medicine, and in 1913, at the 17th International Medical Congress, he read a paper representing the work of many years, on the "Range of Accommodation at many ages."

*Block supplied by the *Medical Press and Circular*.

In 1914, he published a small work on "Problems in the Accommodation and Refraction of the Eye, a brief review of the work of Donders and the progress made during the last 50 years." In the preface he states "Donders' classical treatise was published first in English (it was never published in Dutch) and as a very small return compliment this little book has been published in Dutch."

During the war he acted as Ophthalmic Surgeon to the R.A.F. Hospital, the Masonic War Hospital, the King George Hospital, and the Queen Alexandra Hospital for Officers.

Early in his career he had translated and edited Haab's Atlas of Ophthalmology and in 1931, he produced an "Atlas of Ophthalmoscopy for the Physician," which has been much appreciated. His last contribution to Ophthalmology was a paper read this year at the Section of Ophthalmology of the Royal Society of Medicine, on "Tay's Choroiditis."

Ernest Clarke was a man of wide human sympathies, a brilliant conversationalist and had a very extensive range of interests. As a young man, in company with a well-known clergyman, he visited Ober-Ammergau and in the following winter, these two toured the surroundings of London, holding lecture meetings. The clergyman did the talking and Ernest Clarke did the pictures. They succeeded in collecting £1,000, which was divided among the eye hospitals.

He was a keen Freemason, belonging to a large number of Branches of the Order. He was a Founder and a Past Master of Rahere Lodge and its Treasurer for 21 years, and at his death was Treasurer-nominate of Mark Grand Lodge, and took a keen and practical interest in all its charitable work.

He was a member of the Committee of Management of the Royal Medical Benevolent Fund, to which he rendered very material assistance. As a life member of the Royal Institution since 1896, he served as a "Visitor" for three years and was three times elected to the Board of Managers, the last occasion being in the spring of this year.

His official connection with this Journal dates from 1923, when he joined the Board of Directors. In 1926, on the resignation of Mr. J. B. Lawford, he was elected Chairman of the Board and he continued in this office up to his death. The interests of this Journal were always a prime consideration for him and he worked wholeheartedly and devotedly for it.

He was made a C.V.O. in 1926. He was a skilled musician and and had built himself an organ in his house in Chandos Street and he was an expert croquet player.

He was a sufferer, in the latter years of his life, from a crippling form of rheumatoid arthritis, so that he was seldom free from pain. In spite of this he was never heard to complain, and he maintained

to the end the same cheerful, kindly, disposition which endeared him to so many patients and friends.

He was a Governor of St. Bartholomew's Hospital, a Liveryman of the Goldsmiths' Company, and a member of Pepys' Club, The Oxford and Cambridge Club, and Ranelagh.

He married Kate Litton, daughter of Mr. John Hirst Taylor, of Windermere, and had three daughters, two of whom survive him.

## NOTES

**Death**

As we go to press we learn with profound regret of the death of Mr. Treacher Collins. We hope to publish a memoir in our next number.

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**Appointments**

MR. EDGAR F. KING and MR. B. W. RYCROFT have been elected Assistant Surgeons to the Royal Eye Hospital. Mr. Edgar F. King has been appointed Pathologist to the Central London Ophthalmic Hospital.

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**Folia Ophthalmologica Orientalia**

We extend a cordial welcome to the new ophthalmological periodical of the Levant, which is issued under the above title. The Editor is Dr. Feigenbaum, of Jerusalem, and the journal is very similar in *format* to the *Acta Ophthalmologica*. Papers are printed in English, French and German, with summaries in each language at the end of each paper. There is a goodly list of collaborators. Among the papers in the first fasciculus may be noted, those by Meyerhof on 50 years of ophthalmic progress in Egypt: by Taborisky on the microscopical diagnosis of trachoma; by Rowland Wilson on a slit-lamp study of the corneal vessels in Egyptian trachoma, with excellent colour plates; by Peters on acne rosacea occurring in trachoma; and by the Editor, on the origin of lenticonus anterior. We hope to give more extended notices of these in later issues.

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**North of England Ophthalmological Society**

A SERIES of Lectures will be delivered by Mr. Duke-Elder under the auspices of the North of England Ophthalmological Society in January, 1933. The dates and subjects are as follows:—

January 13, at Sheffield, on "the aetiology and operative treatment of glaucoma."

January 16, at Leeds, on "the aetiology and operative treatment of detached retina."

January 17, at Liverpool, on "the action of drugs on the eye,"

## FUTURE ARRANGEMENTS

### 1933

*January 13.*—Royal Society of Medicine, Section of Ophthalmology.

*January* 13.—North of England Ophthalmological Society, Mr. Duke-Elder, lecture at Sheffield.

*January* 16.—North of England Ophthalmological Society, Mr. Duke-Elder, lecture at Leeds.

*January* 17.—North of England Ophthalmological Society, Mr. Duke-Elder, lecture at Liverpool.

*January* 27.—Midland Ophthalmological Society, at Nottingham and Midland Eye Hospital.

*February* 3.—North of England Ophthalmological Society, at Newcastle-on-Tyne.

*February* 10.—Royal Society of Medicine, Section of Ophthalmology.

*March* 3.—North of England Ophthalmological Society, at Liverpool.

*March* 10.—Royal Society of Medicine, Section of Ophthalmology Clinical Meeting).

*March* 31.—North of England Ophthalmological Society, at Sheffield.

*April* 4.—Midland Ophthalmological Society, at Oxford Eye Hospital.

*April* 17-21.—XIV International Ophthalmological Congress, at Madrid.

*May* 11-13.—Ophthalmological Society of the United Kingdom, Annual Congress, at the Royal Society of Medicine.

*May* 26.—Midland Ophthalmological Society, at Gloucester Royal Infirmary.

*June* 9.—Royal Society of Medicine, Section of Ophthalmology (Annual Meeting).

*July* 5-8.—Oxford Ophthalmological Congress, at Oxford.

*October* 6.—Midland Ophthalmological Society, Annual Meeting, at Birmingham and Midland Eye Hospital.

*December* 5.—Midland Ophthalmological Society, at Birmingham and Midland Eye Hospital.

# CONTEMPORARY OPHTHALMIC LITERATURE

## American Journal of Ophthalmology. *November, 1932.*

SPACKMAN. X-ray diagnosis of double perforation of the eyeball after injection of air into the space of Tenon.
BEISBARTH. Hyperphoria and the prolonged occlusion test.
DOHERTY. Ocular papillomata.
BEERY. Intraocular foreign body with Bacillus welchi infection.
MAYER and RONY. Visual fields, blind spots, and the optic discs in endocrine diseases.
SITCHEVSKA. Contact glasses in keratoconus and in ametropia.
CLAPP. The effect of x-ray and radium radiations upon the crystalline lens.
TASSMAN. Frequency of the various kinds of refractive errors.
VON HALLER BROBECK. Pulsating exophthalmos.
PAYNE. Severance of the medial rectus muscle in an operation for pterygium—reattachment.

## Archives of Ophthalmology. *November, 1932.*

KNAPP. Association of sclerosis of the cerebral basal vessels with optic atrophy and cupping.
CLARK. Purpura haemorrhagica of the Schönlein-Henoch type: Report of a case.
JAMESON. Some essentials and securities which stabilize operations on ocular muscles.
EGGSTON. The use of tuberculin in diagnosis and treatment in ophthalmology.
TOWN and FRISBEE. Bacteriophage in ophthalmology: A preliminary report.
CRIGLER. Subchoroidal hemorrhage diagnosed as sarcoma of the choroid: Report of a case.
BERLINER and NONIDEZ. Transportation of particulate matter from the vitreous into the optic nerve.
CARROLL and BLAKE. Repair following operations on the extra-ocular muscles: Histologic observations.
PARKER. The Todd muscle tuck with a modification.
FRIEDMAN. A new method of registering graphically the ocular pulse.
SPIEGEL. Physiopathology of the voluntary and reflex innervation of ocular movements.

## Annales d'Oculistique. *October, 1932.*

MARQUEZ. Ocular movements, directional and convergent.
MICHAIL. Bilateral hyperplastic inflammation of the semi-lunar folds of nasal origin.
FIETTA. Injuries of the eye by fragments of brass. Toleration and chalcosis.
RISCHARD. Accommodation in birds.

## Archives d'Ophtalmologie. *November, 1932.*

VAN LINT. Extra and intra-capsular extraction of cataract.
MONBRUN and FACQUET. Retrobulbar optic neuritis due to carbon disulphide.
SAINT-MARTIN and MÉRIEL. Glaucoma and medium tension.
GENET. Treatment of retinal detachment by perforating diathermic coagulation.
PONTHUS. New application of "paradoxical vision"; study of astigmatism by Dr. Chanoz' "staircase phenomenon" with coloured light.
DEPLANCHE. Papillomatous tumour of the anterior segment of the eye in a native of the Ivory Coast.

### Revue Générale d'Ophtalmologie. *February, 1932.*

GOURFEIN. Senile cataract and calcium metabolism.

*March, 1932.*

WERDENBERG. New points of view in criticism of the treatment of ocular tuberculosis.

*April, 1932.*

WERDENBERG. Pulmonary symptoms in cases of ocular tuberculosis.

### Revue Internationale du Trachome. *October, 1932.*

PAGES. Concerning an enquiry into treatment by Chaulmoogra oil.
TRAPESONTZEWA. Researches on the b. granulosis of Noguchi.
MME. DELANOE. Thoughts on the pathogenesis of trachoma.

### Klinische Monatsblätter für Augenheilkunde. *November, 1932.*

VOGT. The histology of the normal zonular lamella.
——— Further histological findings in senile desquamation of the anterior capsule.
——— Comparative survey of the clinical and histological aspects of the old and fresh lamellae of the anterior lens capsule.
HOUWER. Is the removal of the capsular lamella in its typical form a sure sign of heat cataract?
LEVY-WOLFF. The genesis of typical epithelial proliferation of the ciliary body.
HANDMANN. Remarks on lamellar cataract and the beginning of senile cataract.
CUSTODIS. Epithelial lining of the anterior chamber.
VOM HOFE. The action of Tenosin on the pupil and intra-ocular pressure.
STREIFF. Demonstration of the physico-optical factors governing the visual disturbance in albinotic eyes, together with remarks on Müller's anti-glare contact lenses.
JUHASZ-SCHAFFER. Case of congenital isolated unilateral ocular palsy.
STREBEL. The asymmetry of the anterior segment of the sclera and its practical and theoretical significance in the ordering of contact lenses.
BEIN and MICHNIEWICZ. Is Oguchi's disease confined exclusively to Mongolian races?
LIPSCHUTZ. Concave tonometer projections.
STIEFBOLD. An unusual bacteriological finding in the contents of a Meibomian cyst.
KLAR. Acute encephalomyelitis of the optic nerve.
VAJDA. Is the approximation test of Falta infallible?
KAYSER. A rare complication in extirpation of the lacrymal sac.
WINKLER PRINS, JUNR. Insulin treatment for clearing degenerative opacities of the cornea.
FRIEDE. Treatment by mineral waters in gross vitreous loss.
KLEIN. Preservation of eyedrops.
GREEFF. An old Peruvian blind exhibition.
FISCHER. An ophthalmological episode of the 18th century.

### Annali di Ottalmologia e Clinica Oculistica.

*April-May, 1932.*

GALLERANI. Allergic phenomena, due to feeding on milk:—transitory blindness, scotoma scintillans and increased palpitation.
MURA. Epibulbar epithelioma.
SANTONASTASO. Ocular changes in leprosy.

QUAGLIO. Indirect visual acuity in chronic simple glaucoma.
RUATA. Vaccine therapy in trachoma and other infections of the eye.
SANNA. Chronic headache of ocular origin, the mechanism of its production, and its clinical significance.
SANTONASTASO. Ocular changes in intracranial hypertension in children.

### Bollettino d'Oculistica. *October, 1932.*

DUMITRU. Researches with t.b.c. antigen by the reaction of Cesare Piazza in the urine of an individual with phlyctenular conjunctivitis.
SGROSSO. On the oxidation (deidrogenition) power of the uveal coat in albinism.
BENCINI. Retinal detachment and Gonin's operation.
FEDERICI. Experiments and researches on a recent method of tattooing the cornea with silver nitrate.
GALEAZZI. Rare observation of persistent pupillary membrane in a case of abnormal development.
RAVERDINO. On the application of the Lindner-Guist method of curing detachment of the retina.

### Archivos de Oftalmologia Hispano-Americanos. *November, 1932.*

FERNANDEZ. The use of tuberculin in ophthalmology.
BORDAS. The use of percaine in ocular therapeutics.
AMAT Treatment of angioma of the lids by electrolysis and by x-rays. Comparison of the two treatments.
ARRUGA. Personal description of the treatment of retinal detachment and a description of recent operative modifications.
AMIAS. Keratitis disciformis in industrial accidents.

### Revista Oto-Neuro-Oftalmologica y de Cirujia Neurologica Sud-Americana. *November, 1932.*

SCHUELLER Cirumscribed cranial osteoporosis.
BLASS. Radiography in examination of the cranium.
PAVIA. A case of hole at the macula in severe iridocyclitis of unknown origin.
MONIS. New ideas about cranial arterio-graphy.
PAVIA, BIANCHI and DUSSELDORP. Pseudo tuberculosis verrucosa of the palpebral conjunctiva and pulmonary tuberculosis.

### Revista de Ophthalmologia de S. Paulo. *July, 1932.*

SOUZA MARTINS. Tears of blood.
CYRO SILVA. Examination of the mouth in relation to the eyes.
ALMEIDO. Special considerations about the surgery of glaucoma.
NERO. Trachoma in the municipality of Botucatu.

### Revue d'Oto-Neuro-Ophtalmologie. *July-August, 1932.*

RENDU. Localised masticatory sudoric reflex. Twenty-four cases due to war injury.
ROGER, POURSINES and ALLIEZ. Trigeminal neuralgia and anaesthesia, paralysis of the VI, and Horner's syndrome in a syphilitic lesion of the tip of the petrous bone.
FAVORY and PETRIGNANI. Familial optic atrophy.